Vol. XX No. 7

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AGRICULTURE, GENERAL

FACTORS AFFECTING THE ORGANIC ACID PRODUCTION BY PROPIONIBACTERIA USED IN THE MANUFACTURE OF SWISS CHEESE

(L. C. Card No. Mic 59-5376)

Ibrahim Salem El-Hagarawy, Ph.D.
The Ohio State University, 1953

The characteristic flavor of Swiss cheese is related to the propionic and acetic acids produced by Propionibacterium starter organisms. The dissertation is a discussion of a study made to obtain basic information regarding the production of these acids by P. shermanii.

The P. shermanii cultures were grown on either a broth or a reconstituted nonfat dry milk solids media at 30°C for 2 to 12 day periods depending upon the factors being studied. The standard broth consisted of 1 per cent of peptone and tryptone and 0.5 per cent of lactose and yeast extract. Chromatographic analysis was used to separate and measure quantitatively the propionic and acetic acids produced in the fermentation.

There was little variation in the maximum amounts of the acids produced by nine of ten strains of P. shermanii in broth media during a 12 day incubation period. The peak of acid production was reached after four to nine days. The maximum amount of propionic acid was reached in less time than it took to reach the maximum amount of acetic acid. The ratio of propionic to acetic acid was approximately 2:1 throughout the first nine days of incubation, then decreased to about 1:1. The metabolic activity of the cultures could not be correlated with the number of organisms at the time of inoculation nor at the time of acid analysis.

Increasing the buffer concentration of the media at the optimum pH for the succinic decarboxylase enzyme (pH 5.2) resulted in an inhibition of bacterial growth, whereas unbuffered media adjusted to pH 5.2 revealed growth by increasing turbidity of the broth media. Buffering the initial pH temporarily at 6.6 permitted an increase in the amount of acid produced during the first two days, but the acid production, compared to the unbuffered control, was delayed after this period. Bicarbonate buffer also retarded acid production in broth media.

The incorporation of 1 per cent sodium lactate in the broth medium resulted in a more rapid rate of propionic and acetic acid production than occurred when lactose was used in the same concentration. After two days incubation, lactate-containing medium yielded five to six times as much propionic and acetic acids as the medium containing an equal quantity of sodium succinate. Broth medium containing 1 per cent sodium pyruvate yielded three to five times as much total acid as the medium containing the succinate.

In comparison to the standard broth medium, a lag in acid production occurred when glucose was substituted for lactose and when succinate was added with lactose to the broth medium. The incorporation of 0.001 molar concentration of adenosine triphosphate in the broth had no apparent effect on the fermentation during six days of incubation.

A pH below 6.0 was not required for production of large amounts of acids in broth media. With initial pH values of 5.2, 5.4, 5.8 and 6.6, the acid production was retarded less than it was by subsequent decreases in pH.

The addition of 0.5 per cent yeast extract to a reconstituted milk medium caused the production of 2.25 to 4.5 times the amount of acids produced in the milk control after four days of incubation. The incorporation of 1 per cent sodium lactate in the milk medium stimulated acid production so that increases above the control were in the range of 50 to 400 per cent. The addition of 0.1 per cent peptonized milk or 1 per cent casein hydrolysate to the milk medium resulted in increases in acid production of up to 350 per cent over that of the control medium. Liver extract concentrate or liver fraction L in 0.1 per cent amounts produced only slight stimulation. The addition of biotin, thiamine, pantothenic acid, or P-aminobenzoic acid to the milk medium had no effect on acid production. Lowering the oxidation-reduction potential by the addition of sodium thioglycollate to the reconstituted milk resulted in retardation of acid production.

On the basis of this study it appears that the addition of 0.5 per cent yeast extract makes milk a good growth medium for P. shermanii. The results suggest that the addition of yeast extract to milk for Swiss cheesemaking might hasten the flavor development.

Microfilm $2.50; Xerox $6.60. 140 pages.

Abstract published by special arrangement with The Ohio State University.

THE VEGETABLE INDUSTRY OF MISSOURI

(L. C. Card No. Mic 59-5639)

Jesse Cother Grady, Jr., Ph.D.
University of Missouri, 1959

Supervisor: Dr. Frank Miller

It is known that Missouri is not growing as many acres of vegetables as have been produced in the past decade and that producers in the state are facing rigorous competition from other states. This study has been made to determine the current position of the industry, the conditions which have instigated this position and the adjustments which can be made to improve the future position.

The data collected were from four distinct areas of the state which were designated the St. Louis area, the Kansas

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

City area, the Southwestern area and the Southeastern area. The acreage of commercial vegetables was tabulated by counties to determine where the major crops were produced. County agricultural agents and state extension personnel helped in making a list of growers from which the sample could be taken. Data were collected by personal survey. An effort was made to get data on the type of operation, ownership of land, time spent in vegetable farming, anticipated changes, equipment and facilities used, acreage, type of area in which the farm was located, use of irrigation water, how, when and where crops were marketed and method of sale.

The major vegetable crops of Missouri are sweet corn, tomatoes, watermelons, cantaloupes, cabbage, strawberries and spinach. The acreage of vegetables grown declined steadily from 48,826 acres in 1935 to 12,831 acres in 1954. In the metropolitan areas, industrial and residential expansion has priced the land beyond frugal agricultural uses.

The total acreage in vegetables and the acreage of each crop on individual farms are small. With this limited volume it is not economically feasible for the producer to grade his product or maintain quality after harvest through cooling, storing and packing under recommended temperature and humidity conditions. A coordinated effort to intensify the production and marketing of fewer commodities should be made. The potentiality of sweet corn produced for the fresh market is promising.

Rainfall is not sufficient and the use of irrigation is far below what is considered adequate for profitable production. As a result the quality of the product is often inferior and the yields per acre very low in comparison to other states.

The state has two major wholesale fruit and vegetable markets in St. Louis and Kansas City. The wholesale market in St. Louis is one of the newest and most modern in use today. The Kansas City market is inadequate from the standpoint of rail facilities, size of units and accessibility. Market outlets predominately utilized were the commission men and the processor, though the number of processors has declined from over three hundred to less than ten at the present time in the Southwestern area where the processing industry was centered.

Cooperation among the producers is needed. Even though each truck farmer has small volumes of produce, pooling of several farmers' products would permit and encourage sorting and standardizing of qualities and the use of more capital equipment for the maintenance of quality after harvest. Under these conditions the local groups would have a better product to offer the buyer who demands that produce meet the high quality specifications of the present day mass markets.

Microfilm $2.50; Xerox $7.00. 146 pages.

SORPTION CAPACITIES, ION SATURATIONS AND NEUTRALIZATION MECHANISMS OF CLAYS AND SOILS.

(L. C. Card No. Mic 59-6563)

Clara Ju-Yuan Lin, Ph.D.
North Carolina State College, 1959

Supervisor: Nathaniel Terry Coleman

Soils and clay minerals possess permanent charges, probably due to isomorphous substitution. At pH above 5, additional charge develops, particularly in red soils containing kaolin and iron oxides. The removal of iron oxides increases the cation exchange capacities of red soils, indicating that some permanent charges of these soils were blocked by the iron oxides.

The greater hydrolysis of K^+ or Ca^{++} from montmorillonite at pH above 6 suggests that cations are held relatively strongly by the permanent charges, but less tightly by the weakly acidic groups of unknown nature developing at higher pH's. With Cecil soil, there was more hydrolysis of K^+ at lower pH. Besides, equivalent amounts of Cl^- were found in the washings from the Cecil. This probably was due to the presence of free salt occluded in the flocculated clay plates at low pH's.

Kaolinite, and particularly red soils, possesses positive charges under acid conditions, as revealed by the positive anion sorption. The anion sorption capacity is not a constant value, but depends upon the pH, the nature and concentration of anions, the nature of the sorbing material, and the presence or absence of other anions in the system. Iron oxide removal from red soil reduced and iron oxide coating on kaolinite increased anion sorption, suggesting that iron oxides had played an important role in developing sorption sites.

Hydrogen ions added to the red soils as HCl or H_2SO_4 were sorbed in amounts equivalent to the sum of the cation exchange capacity and the quantity of anion sorbed, indicating that a portion of the H^+ underwent cation exchange, with another portion sorbed during the development of anion sorption sites.

Most of the cations displaced from a number of acid soils upon leaching with 1 N KCl were Al^{+++} ions, and the sums of the cations displaced were equivalent to the corresponding exchange capacities. Apparently, under natural acid conditions, the permanent charges of soils are countered dominantly by Al^{+++}. One tenth N KCl solution was less effective than 1 N KCl in displacing Al^{+++}. Upon increase in salt concentration to 3 N, the rate of displacement was not affected. The total amounts of Al^{+++} displaced by 1 N solutions of KCl, $CaCl_2$, and NaCl were the same, though the rate of displacement was somewhat slower with NaCl. The amounts of exchangeable Al^{+++} measured by neutral salt displacement, by potentiometric titration, and by conductometric titration were in good agreement, provided clearly defined end points could be obtained in the titration methods.

In aqueous solution, two-thirds neutralized $AlCl_3$ formed hydroxyaluminum complexes of high molecular weight. After long standing, the soluble complexes were destroyed, with the precipitation of gibbsite and the liberation of free Al^{+++} ions.

The hydroxy-aluminum complexes formed upon the addition of base to Al-exchange resin interacted with the

functional groups of the resin to block its exchange capacity. This was not the case in soil and clay mineral systems, since no reduction in capacity was obtained in partially neutralized Al-bentonite and White Store soil. Rather, the end products were found to be $Al(OH)_3$ and Al^{+++} ions remaining on the exchange sites. Apparently, in soil and clay systems, the formation of $Al(OH)_3$ at the expense of intermediate polymers is somehow accelerated.

Microfilm $2.50; Xerox $5.40. 109 pages.

EFFECT OF PROFILE STRATIFICATION AND OTHER FACTORS ON WATER INFILTRATION

(L. C. Card No. Mic 59-6416)

David E. Miller, Ph.D.
State College of Washington, 1959

Supervisor: Dr. W. H. Gardner

A laboratory investigation was made of the effects of various factors on the rate of infiltration and the advance of the wetted-front in soil and other porous materials. During the course of this investigation a recording infiltrometer was devised, and a method developed for obtaining uniformly packed tubes of soil. Rate of infiltration and position of the wetted-front data as a function of time were obtained for wetting of soil conditioner treated Palouse silt loam, pumice, various size ranges of Palouse silt loam aggregates, and several other soils. These data were used to test a number of infiltration equations that have been proposed in the literature, and it was found that none of the equations tested adequately described the experimental data.

Investigations were made on rate of infiltration and wetted-front advance as influenced by textural and structural stratification, initial moisture conditions, temperature, and air pressures within the soil.

The effects of strata within the soil were related to the pore sizes in the stratifying material compared to those in the surrounding soil. If many of the pores in a layer were larger than those in the surrounding soil, infiltration was temporarily inhibited after the wetted-front reached the layer, and the degree of inhibition was increased if the pore sizes in the layer were increased. Water must accumulate at a layer:soil interface until it is at a tension low enough to allow it to move into the pores of the layering material. Since this accumulation takes time water movement into the surface is decreased while the accumulation goes on.

A given stratifying material inhibited water movement into soil by upward wetting much more than by downward wetting because the accumulation of water at the layer:soil interface is much slower against the pull of gravity than with it. Aggregate layers did not inhibit water infiltration as much as sand of the same size range because of the small pores within the aggregates. These small pores, absent in sand, conducted water when the wetted-front reached the layer before the moisture tension at the interface was low enough to allow the pores between aggregates to fill. If the stratifying material was finer than the surrounding soil, water movement was inhibited after the wetted-front contacted the layer to a degree dependent upon the ability of the wetted layer to conduct water.

The effect of blocking a portion of the soil cross-section from conducting water was influenced by the depth at which blockage occurred. Blocking 60% of the surface soil had no effect on infiltration except during the first few seconds, while at depths of 2.5 and 3 cm. infiltration was inhibited for several hours after the wetted-front reached the blocked area.

Infiltration rates increased and the wetted-front advanced more rapidly as the temperature of the system was increased up to 30° C. The differences between 30° and 40° C. were small and not consistent with the data obtained at lower temperatures.

Significant air pressures were built up in a closed column of soil when water was applied to the surface. Infiltration and wetted-front movement were decreased when the air pressure within the soil was increased. The wetted portion of the soil contained less moisture when air pressure was built up in the soil than when it was not.

Microfilm $2.50; Xerox $7.60. 162 pages.

AGRICULTURE, ANIMAL CULTURE

BLOAT AND BLOAT PROPHYLAXIS AND THEIR RELATIONSHIP TO CERTAIN PROPERTIES OF RUMEN INGESTA AND BLOOD

(L. C. Card No. Mic 59-5664)

Lynn Ranney Brown, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: N. L. Jacobson

The objectives of this study were: (1) to measure the effects of penicillin, crude soybean oil and n-decyl alcohol as bloat preventives when cattle were fed alfalfa soilage; (2) to determine the mode of action of these preventives; (3) to study various factors associated with the etiology of "pasture" and feed lot bloat; and (4) to determine various physical and chemical changes that take place in rumen ingesta and blood that may provide basic information as to the cause of bloat and cause of death from bloat.

Penicillin, at the rate of 75 mg. per animal per day, reduced bloat considerably for a 10-day experimental period when cattle were receiving alfalfa soilage. Following the penicillin treatment and a recovery period of several weeks, subsequent daily administration of penicillin was ineffective in reducing bloat either on alfalfa soilage or on a feed lot diet.

Crude soybean oil (0.25 lb. per 1000 lb. body weight per day) applied to soilage at the time of feeding was a very effective method of controlling bloat. Daily doses of 18 ml. of n-decyl alcohol per 1000 lb. body weight had little effect as a bloat preventive; however, this preventive was not tested under conditions of severe bloat.

Lard oil and n-decyl alcohol were effective agents for treatment of animals suffering from severe bloat. Within a very short time after treating severely bloated animals with either of these agents, large amounts of gas were

released either by eructation or by stomach tube and the animals usually recovered completely within 15 to 45 minutes.

Feed lot bloat was produced on several high concentrate-low roughage diets. It was observed repeatedly that bloat increases with time on feed lot diets. In order to produce feed lot bloat experimentally, the roughage intake must be carefully controlled.

Regardless of diet, ingesta from bloated animals had higher surface tension values, higher ingesta-volume-increase values and higher per cent solids values than ingesta from non-bloated animals. On the other hand, foam volume and stability were less for ingesta from bloated animals than from non-bloated animals.

No consistent differences in chemical composition were found between forage that caused bloat and forage that did not cause bloat.

Changes in the chemical composition of the blood due to bloat in cattle grazing alfalfa pasture were measured. Phosphorus of whole blood, plasma inorganic phosphorus and plasma lipid phosphorus were higher in bloated animals than in non-bloated animals. Bloat had no effect upon blood ammonia or non-protein nitrogen.

Microfilm $2.50; Xerox $7.60. 161 pages.

SOME EFFECTS OF CHRONIC AND ACUTE FLUORIDE LEVELS ON METABOLISM AND DISTRIBUTION OF F^{18} IN SELECTED TISSUES OF CATTLE

(L. C. Card No. Mic 59-5665)

Charles Calvin Chamberlain, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dr. Wise Burroughs

Animals ingesting even rather large chronic levels of fluoride had little or no difference in apparent digestibility of feed using conventional digestion techniques. Using the artificial rumen technique, it was demonstrated that it took levels of fluoride toxic to the animal within sixty to one hundred twenty days, to obtain a highly significant reduction in cellulose digestibility. However, a straight line relationship between fluoride level and cellulose digestibility was not obtained.

The interrelationship between magnesium, manganese and fluoride shown by workers using single strains of microorganisms was also demonstrated using mixed suspensions of rumen microorganisms. When both manganese and magnesium were omitted there was a highly significant reduction in cellulose digestion, but the addition of fluoride did not further reduce the cellulose digestion, however.

Weanling and adult albino rats demonstrated marked alterations in blood glucose and lactate levels and liver and muscle glycogen soon after 300 p.p.m. of fluoride was added to the ration. These alterations returned to normal (90 to 110 per cent) within three to four weeks. There was a definite difference between the weanling and the adults both as to the degree of alteration and as to the recovery time.

Acute toxic doses of fluoride (200 to 250 mg./kg.) injected intraparateniolly or subcutaneously into weanling lambs or pigs resulted in marked alterations in blood glucose and lactate and liver and muscle glycogen. There seemed to be a species difference in the quantity of fluoride tolerated and in administration site between lambs and pigs.

Seven to eleven month old calves and seventeen to twenty-two month old yearling cattle were fed 300 p.p.m. of fluoride for a period up to 55 days. No difference in the blood glucose between those receiving fluoride and the controls was observed.

After thirty-five days cattle from both age groups were dosed with radioactive fluoride periodically. Definite age differences were demonstrated in the rate of removal of the isotope from the bloodstream, the excretion pattern in the urine, and deposition in the bone. The younger animals appeared to metabolize the isotope at a faster rate than did the yearlings.

Blood studies showed that about seventy-five per cent of the isotope appearing in the blood was in the plasma fraction, and that it was distributed about equally between the protein and non-protein fractions. The removal rate of the isotope from the blood was very rapid. Three of the tissues studied, thyroid, liver and spleen appeared to have retention of the isotope independent of the blood level.

The isotope appeared in the saliva within a very short time after intravenous injection. This coupled with appearances in the gastro-intestinal tract and the feces indicates a recycling of fluoride in the metabolic pool. The short half life of the isotope did not permit balance and/or equilibrium studies. Similarities previously suggested concerning bone deposition of calcium and fluoride were confirmed by this study.

Microfilm $2.50; Xerox $7.40. 156 pages.

A STUDY OF THE RELATIONSHIP OF PROTEIN AND ENERGY IN CAGED LAYER NUTRITION

(L. C. Card No. Mic 59-5510)

Buster Hall Davis, Ph.D.
Louisiana State University, 1959

Supervisor: Dr. A. B. Watts

A four factor factorial experiment was conducted to study the relationship of protein, energy, calcium and pyridoxine. Criteria for the evaluation of these variables were, egg production, egg weight, specific gravity of eggs, feed efficiency, carcass composition and digestibility of protein, fat and calcium. Four hundred and eighty, individually fed White Leghorn hens were involved in this study.

The 18 percent level of protein was significantly better for egg production than the 15 percent level. This was due in part if not entirely to the interrelationships of protein with calcium and protein with pyridoxine. In both cases the higher level of pyridoxine and calcium resulted in a depression of egg production on the 15 percent protein rations. This effect was not observed on the 18 percent protein rations.

Energy level made its greatest contribution in reducing

the daily feed intake and the feed required per egg produced. Energy had no effect on production but the 1000 calorie level did result in increases in egg weight and egg specific gravity. These increases were due in part if not entirely to an energy with pyridoxine interaction on egg weight and energy with calcium interaction on egg specific gravity. The fat contained in the 1000 calorie diets was significantly more digestible than that contained in the 800 calorie diets. This higher digestibility was evidenced in higher carcass fat.

The addition of pyridoxine to the rations resulted in a significant reduction in egg production. This reduction occurred on the lower protein level with no apparent effect on production on the higher protein rations.

Because of the interrelated effects of the variables in this study care should be exercised in interpreting the results from any one of these variables without due recognition of its interrelationships with other nutrients.

Microfilm $2.50; Xerox $4.20. 79 pages.

THE INFLUENCE OF RATIONS CONTAINING SODIUM ACETATE AND SODIUM PROPIONATE ON THE COMPOSITION OF TISSUES FROM FEEDER LAMBS

(L. C. Card No. Mic 59-6613)

Gladys Williams Royal, Ph.D.
The Ohio State University, 1954

Introduction

It is often said by many people in the meat industry that the flavor of meat from grass-fed animals differs from that of corn-fed animals. If so, this may be a reflection of differences in quantities and types of products resulting from the digestion of cellulose and starch.

Historical

Cellulose digestion is restricted to those animals which have been adapted to it by means of an enlarged caecum and colon or by means of an enlarged gastric system such as that found in ruminants. The ox, sheep, and goat are considered the most important ruminating animals. Because of the basic technique of creating rumen, fistulas[1,2] and modifications which use cannula, cattle and sheep have been studied most extensively. The apparent digestion of cellulose by the ruminant is in reality the result of fermentation carried on by microörganisms living symbiotically in the rumen. It is in the rumen that the major portion of cellulose is digested.[3]

The digestive products found in the rumen include volatile acids, vitamins, and ammonia; however, concentrations are dependent upon the types of ration and microorganisms present in the rumen.[6,7,8] When starch or cellulose is fermented, there is a difference in the proportion of volatile acids produced from the two sources, although acetic, propionic, and butyric acid are always formed.[9,10] A starch-containing ration yields principally butyric acid, whereas cellulose fermentation gives rise to more acetic acid.[11]

Much of the volatile acid produced in the rumen is absorbed directly into the blood draining the rumen, afterwhich it is used in intermediary metabolism of fats, carbohydrates, and protein.

Purpose

The purpose of the investigation was to study the effects of sodium acetate and sodium propionate in an adequate ration for feeder lambs. Comparisons were made of the volatile acids present in the rumen—of their distribution as well as that of other metabolic acids in the blood, liver, and muscle tissue; and these findings were studied in relation to the flavor and composition of the meat.

Experimental

Twenty-four lambs of Shropshire breed and Columbia-Shropshire crosses were randomly assigned to one of four rations. The animals, on the basis of the rations fed them, were divided into four groups: Lot 1, Lot 2, Lot 3, and Lot 4. Three wethers and three ewes were included in each of the lots which received a supplement. Five wethers and one ewe were included in the control lot. Six of the original 24 lambs (Lot 1) were fed a basal ration which contained corn, urea, cerelose, and hay; six (Lot 2) were fed the basal ration and a supplement of sodium acetate; six (Lot 3) were fed the basal ration and a supplement of sodium propionate; and the remaining six (Lot 4) received the basal ration and a supplement of equal weights of sodium acetate and sodium propionate.

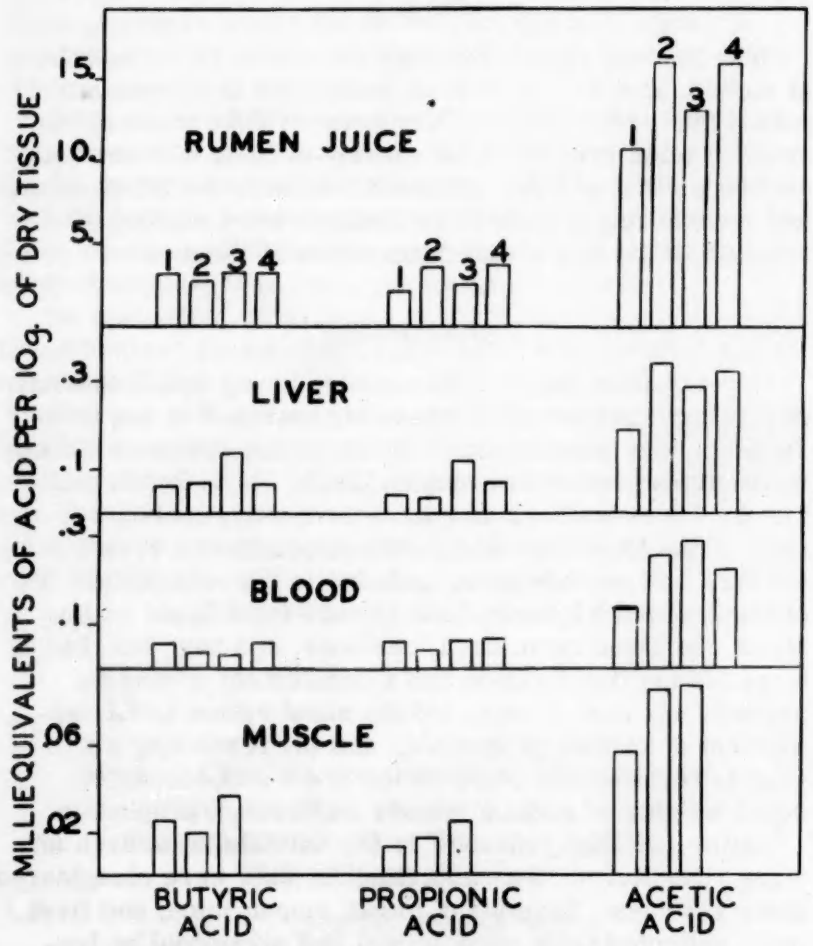
After 109 days, one-half of the animals from each lot were slaughtered; the remaining animals were slaughtered after 123 days. Samples of blood, rumen juice, and liver were collected from each animal and preserved by lyophilization. Lyophilized samples of blood, rumen juice, liver, and meat were individually analyzed for acetic, propionic, butyric, formic, fumaric, glutaric, lactic, succinic, alpha-ketoglutaric, trans-aconitic, malic, and citric acids by the chromatographic technique of Bulen, Varner, and Burrell.[12] Fresh lamb shoulder samples from Lots 1, 2, and 3 were tested for roast shrinkage; pH, moisture, and fat content; and for flavor in roasts (by means of a taste panel).

Results and Conclusion

Growth and feeding data substantiated the observations that sodium acetate and sodium propionate are palatable and seemed to increase the efficiency of the basal ration when included as a supplement. The amount of corn, urea-cerelose mixture, and hay required to produce a 100 pound gain in weight was reduced. A combination of the two organic acid salts in a mixture increased the efficiency above that was observed with acetate or propionate alone.

The volatile acids, acetic, propionic and butyric, were present in each of the tissues studied (Fig. 1). Although all lots contained these acids, some animals within the lots did not contain quantities in all tissues which could be detected under the conditions of the experiment. The concentration of all three acids increased from shoulder to blood, to liver, to rumen juice. Acetic acid represented from 45 to 88 per cent of the total volatile acids; however, there appeared to be no significant difference in the ratios of butyric and propionic acids in any of the tissues.

Fig. 1.—
The Influence of Rations Containing Sodium Acetate and Sodium Propionate on the Distribution of Volatile Organic Acids in the Tissues of Lambs



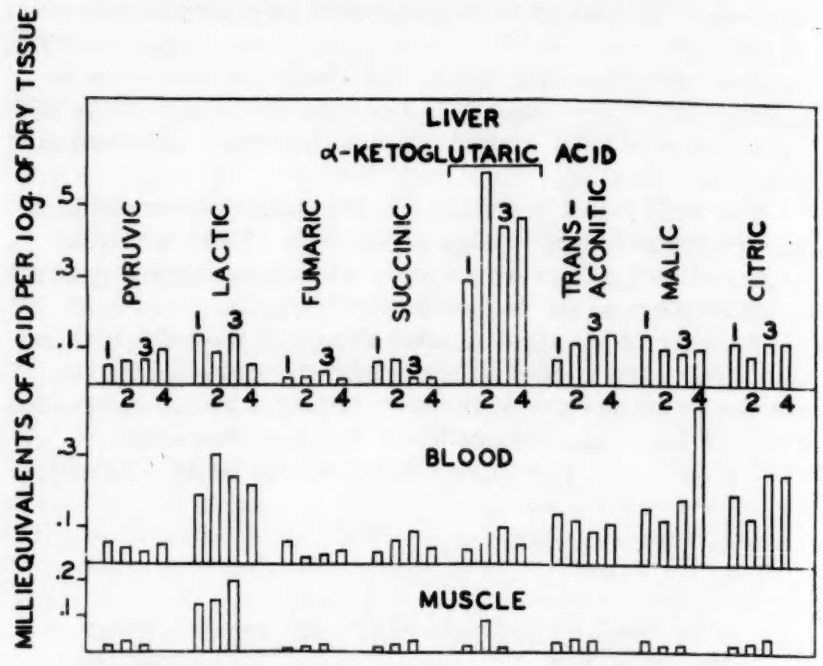
1 - Control
2 - Acetate
3 - Propionate
4 - Acetate plus propionate

Variations within lot were such as to make any real differences between the volatile acid levels produced with the control ration and either supplemented ration questionable.

All metabolic acids considered—pyruvic, lactic, fumaric, succinic, alpha-ketoglutaric, trans-aconitic, malic, and citric acids—were detected in liver, blood, and meat (Fig. 2); however, none of these acids were detected in rumen juice at the sample level employed. Pyruvic, lactic, and succinic acid were present in approximately equal molar concentrations in muscle, blood, and liver. Fumaric, trans-aconitic, malic, and citric acids were present in approximately equal milliequivalent amounts in blood and liver, but decreased by a factor of ten in meat. Alpha-ketoglutaric acid levels were approximately equal in blood and meat, but were 4 to 20 times higher in the liver. Animals whose rations contained either organic salt showed higher levels of alpha-ketoglutaric acid in the liver than did the control animals. Acetate was more effective in causing this elevated level than propionate.

Moisture, pH, fat, and roast shrinkage analysis indicated that variations within the lots were of the same order of magnitude as the variations between the lots. Hence, real differences between values for the control animals and animals which received either organic salt are questionable. Acetate supplemented rations produced

Fig. 2.—
The Influence of Rations Containing Sodium Acetate and Sodium Propionate on the Distribution of Other Metabolic Acids in the Tissues of Lambs



1 - Control
2 - Acetate
3 - Propionate
4 - Acetate plus propionate

animals with lowest average roast shrinkage and least variation within the lot. Acetate and propionate supplemented rations each produced animals with higher average fat and lower average moisture contents than did the control ration. pH measurements indicated that less free acid was present in the muscle of animals which received the acid supplement.

Taste panel studies indicate that differences in flavor between control and acetate or propionate supplemented animals were of such magnitude as to allow an odd sample to be differentiated when the control was compared with two samples from one animal in other lots. The detection in flavor differences was more uniform with experienced tasters than with inexperienced tasters. When either sodium acetate or propionate are included in the ration of feeder lambs, the flavor in meat apparently is altered. There was no attempt to determine superiority or inferiority of the altered flavor.

It may be possible that an interrelationship does exist between the presence of organic acid salt in the ration and the dressing percentage of feeder lambs; production of volatile acids in blood, liver, and meat; alpha-ketoglutaric acid content of liver; pH, moisture and fat content, and flavor in meat. Nevertheless, wide variations within lots do not allow a clear cut definition of this relationship. The inclusion of sodium acetate or sodium propionate to replace corn or other feed stuff in the ration of feeder lambs is possible.

Conclusions

From these results, it was concluded that feeding sodium acetate or sodium propionate to lamb causes —

1. A decrease in the amounts of corn, cerelose, and hay required for a unit gain in weight

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

2. An increase in acetic acid levels in the rumen juice, liver, blood, and muscle
3. An increase in the α-ketoglutaric acid levels in liver
4. An alteration in pH, moisture, fat content, and roast shrinkage of meat, although no definite pattern is evident
5. An alteration in meat flavor to such an extent that the sample can be distinguished by taste from the control

Feeding sodium propionate causes an increase in butyric and propionic acid levels in muscle and liver. Feeding sodium propionate and sodium acetate has generally the combined effects of the individual acids.

Microfilm $2.50; Xerox $5.00. 98 pages.

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Abstract published by special arrangement with The Ohio State University.

STUDIES OF BODY FAT COMPOSITION OF LIVE STEERS USING TRITIUM, ANTIPYRINE, AND N-ACETYL 4-AMINOANTIPYRINE DILUTION METHODS.

(L. C. Card No. Mic 59-3981)

Richard Phil Shumway, Ph.D.
Utah State University, 1959

Major Professor: Dr. James A. Bennett

Investigations were conducted to determine the value of antipyrine, N-acetyl 4-aminoantipyrine (NAAP), and tritium for estimating body fat in steers. Comparisons were made between body fat determinations using these materials and body fat as determined by carcass analysis.

Antipyrine

Body fat determinations, following antipyrine injections to determine body water, were made. Of twelve steers thus tested, only seven gave results which were at all logical. Four showed inverse curves (increasing blood concentrations of the drug after the third hour). One showed an entirely abnormal blood concentration of antipyrine. Percent fat from antipyrine determination compared to percent fat from carcass analysis showed a correlation of 0.56 which was below the level of significance.

Failure to deliver the entire injection into the jugular vein was believed to be one cause of the inverse curve. Two animals which gave inverse antipyrine curves also gave inverse tritium curves when injected simultaneously with both solutions. It was believed that future tests might well make use of tranquilizers to aid in more accurate injection.

NAAP

NAAP was found to be stable in blood plasma when stored for several days. Tests for NAAP concentration in three-day refrigerated samples proved to be equal to that in the fresh sample.

Steers injected one week and reinjected one week later gave results which were fairly well correlated (r = .75). This was significant at the 5 percent level.

There were 20 steers used in NAAP injection and slaughter experiments. One group injected in 1957 gave good results with a correlation of 0.78 between ether extract determinations and NAAP calculations. This was significant at the 5 percent level. However, the 1958 group which was a very wild group of steers had a low correlation. Five out of 11 of the 1958 steers gave inverse curves. When all steers are compared, the variations between NAAP and ether extract determinations are quite large (-5.3 to + 9.7). This large variation makes it impossible to develop an accurate estimating equation with the figures available. However, if more data were obtained it might be possible to develop a reliable estimating equation.

Tritium

Tritium transfers from the blood and/or other body fluids into the rumen begins to occur soon after injection

of tritium into the blood stream. The concentration in the blood and rumen contents is equal in approximately six to seven hours in cattle held off feed and water for 24 hours.

Tritium concentration in urine is equal to or greater than the tritium concentration in blood three hours after injection time. The concentration of tritium activity in urine reflects the tritium level of the blood which flowed through the kidney at an earlier period.

The biological half-life for tritium was found to be 6.4 days in steers.

Of the 33 steers used in tritium trials, three showed inverse curves and two were noted at injection time to have been inaccurately injected. The 33 animals were injected in three groups. The 1956 and 1957 groups were both well correlated with the ether extract calculations. These correlations were significant at the 1 percent level. The 1958 group gave a low correlation as they also did in the NAAP studies.

When all of the steers used in the tritium studies were compared with the ether extract calculations, a correlation of 0.79 was obtained. This was significant at the 1 percent level. The estimating equation, $\hat{y} = 5.50 + .741X$, gives the best estimation of percent fat in the empty body when percent fat from tritium injections is known.

Specific gravity

The percent fat found by the specific gravity method was well correlated with the ether extract method. ($r = 0.92$). Microfilm $2.50; Xerox $4.40. 83 pages.

THE ZINC REQUIREMENT OF THE GROWING PIG AND ITS RELATION TO SOURCE OF PROTEIN

(L. C. Card No. Mic 59-6516)

William Harold Smith, Ph.D.
Purdue University, 1959

Major Professor: W. M. Beeson

Four experiments were conducted in this study. Three of the experiments were concerned with quantitating the zinc requirement of the growing pig and the fourth with the effect of source of protein on the zinc requirement. Three-week-old Duroc pigs were used in all experiments. An isolated soybean protein basal ration containing 16 ppm zinc was used in all experiments with some modifications in the fourth experiment. Evaluation criteria used were: growth rate, feed consumption, feed efficiency and the incidence and severity of parakeratosis. Six to eight pigs per treatment were used and the pigs were self fed indoor on concrete-floored pens.

In the first experiment the following levels of zinc were tested: 16, 21, 26, 31, 36, 41 and 46 ppm. The average daily gain increased with each increment of zinc from 0.06 to 0.76 pound for the pigs receiving 16 and 46 ppm zinc, respectively. Also, the feed required per pound of gain decreased with each increment of zinc. All pigs fed 16, 21, 26, four receiving 31 and three receiving 36 ppm zinc developed parakeratosis. The characteristic symptoms of a zinc deficiency were: decreased feed and water intake, retarded growth, scours, rough hair coat, fading of hair color, severe paining when handled, standing with all four feet placed together and parakeratosis. The first noticeable symptom of a zinc deficiency was retarded growth. Within a week later parakeratotic lesions were evident on the ventral side of the abdomen. Two pigs died from a zinc deficiency in the group fed 16 ppm zinc.

The second experiment was designed very similar to experiment I, except the following levels of zinc were fed: 36, 41, 46, 51, 56 and 61 ppm. The highest average daily gain of 1.28 pounds was obtained with 41 ppm zinc in contrast to the lowest of 1.21 pounds with both 56 and 61 ppm zinc. None of the differences were statistically significant. No parakeratosis was observed in any of the treatments.

Experiment III was designed very similar to experiment I and II, except the following levels of zinc were fed: 26, 31, 36, 41, 46 and 51 ppm. The average daily gain increased from 0.29 pound for the pigs receiving 26 ppm zinc to 1.06 pounds for the 46 ppm zinc with no further increase on the 51 ppm zinc. Forty-one ppm zinc prevented parakeratosis and supported 1.00 pound average daily gain which was only 6 per cent below the maximum average daily gain of 1.06 pounds. Feed required per pound of gain decreased from 4.04 pounds for the pigs receiving 26 ppm zinc to 2.05 pounds for the 41 ppm zinc with no further decrease with the 46 or 51 ppm zinc. All pigs receiving 26, four receiving 31, and two receiving 36 exhibited symptoms of parakeratosis.

A fourth experiment was designed to evaluate the effect of source of protein on the zinc requirement of the growing pig. The following protein rations with the respective zinc content in ppm were evaluated: isolated soybean protein, 16: soybean oil meal, 22: dried skimmed milk, 16: commercial casein, 18, and vitamin-free casein, 6. The average daily gains in pounds for the above rations for the first five weeks were: 0.13, 0.27, 0.67, 0.46, and 0.47, respectively. The group fed dried skimmed milk gained significantly faster ($p. < .01$) than the other treatments. All of the groups receiving the various milk proteins gained significantly faster than the groups fed plant proteins.

The feed required per pound of gain for isolated soybean protein, soybean oil meal, dried skimmed milk, commercial casein and vitamin-free casein rations was 6.86, 3.36, 2.10, 2.26 and 2.02 pounds, respectively. All pigs fed the isolated soybean protein or the soybean oil meal rations developed symptoms of parakeratosis.

At the end of five weeks each group of 8 pigs was allotted into two groups on the basis of previous gain. One group in each treatment was continued on the original ration and the other group in each treatment was fed the original ration plus 50 ppm zinc. No benefit was obtained by adding zinc to the milk protein rations. In fact, the average daily gains for the groups receiving commercial casein and vitamin-free casein were retarded 12 and 22 per cent, respectively. However, when 50 ppm zinc was added to the plant protein rations, the average daily gain increased tremendously from -0.05 to 1.55 pounds for the soybean oil meal group and from -0.15 to 1.10 pounds for the isolated soybean protein group. Feed required per pound of gain for the pigs showing no parakeratosis at the end of 28 days varied from 1.91 to 2.37 pounds. All pigs that received plant protein with no added zinc exhibited

severe parakeratosis at the end of nine weeks. The pigs fed the plant protein rations plus 50 ppm zinc completely recovered from the symptoms of parakeratosis within 28 days.

The repletion studies demonstrated that zinc, commercial casein or dried skimmed milk alleviated parakeratosis.

In summary these data revealed:

1. Zinc was a necessary constituent of the ration for the growing pig.
2. The zinc requirement of the growing pig was 46 ppm when isolated soybean protein was fed as the source of protein.
3. Source of protein affected the zinc requirement of the growing pig.

Microfilm $2.50; Xerox $6.60. 137 pages.

AGRICULTURE, FORESTRY AND WILDLIFE

POPULATION ECOLOGY AND MANAGEMENT OF WHITE-TAILED DEER IN THE CHOCCOLOCCO WILDLIFE MANAGEMENT AREA, ALABAMA.

(L. C. Card No. Mic 59-5269)

William Hensley Adams, Jr., Ph.D.
Alabama Polytechnic Institute, 1959

Supervisor: A. M. Pearson

The basic ecology of a white-tailed deer, Odocoileus virginianus (Zimmermann), population was investigated on the 40,000-acre Choccolocco Wildlife Management Area in north-eastern Alabama from September, 1956, through May, 1959. This is a ruggedly-dissected region characterized by a mixed pine-hardwood forest and shallow soils with low fertility. Its game resources are afforded a high degree of natural protection via its inaccessibility.

History. Deer were apparently exterminated from this region during the early 1900's. Approximately 65 deer of mixed ancestry and unknown age and sex were released in the Choccolocco Area between 1938 and 1941. A total of 898 legal bucks has been removed during twelve successive seasons of hunting since 1948.

Methods. The Choccolocco range was surveyed during the summer of 1957 and winter of 1958 by using line-intercepts 100 feet long and 4½ feet high. One hundred sample lines were randomly located throughout the representative 16,000-acre Shoal Creek drainage.

Pertinent data were obtained from hunting records maintained in the Choccolocco Area since 1953. Age estimates of deer were based on tooth development and wear. Pregnant does were collected at intervals throughout the 1957-58-59 gestation periods. Ovaries from these does were examined macroscopically for corpora lutea. Embryos were aged by comparison with known-age embryos obtained from captive does. Fifty-eight stomach samples were obtained for seasonal food habits analysis.

Results. Vegetation below a browse level of 4½ feet occupied less than one-half the total Choccolocco Area during any season of the year. On an annual basis, Vaccinium vacillans Torr., was the most important browse species. Other heavily browsed species included Smilax spp., Hydrangea spp., Rhus copallina L., Euonymus americanus L., Kalmia latifolia L., Symplocos tinctoria (L.) L'Her., Viburnum spp., Liriodendron Tulpifera L. and Nyssa sylvatica Marsh.

Stomach samples supported range survey findings and, additionally, revealed the importance of acorns, fungi, lichens and litter. Acorns were ingested almost to the exclusion of litter when available in late fall. Litter appeared in inverse ratio to the amount of live forage available during the winter season. Range deterioration was correlated with increased numbers of spike bucks, does with single embryos after initial pregnancy and deer in poor physical condition.

The January, 1959, deer population consisted of approximately 2,000 breeding animals with a sex ratio of 1 male to 3 females and a previous summer crop of about 1,500 fawns. The interaction of sex and maturity resulted in the distribution of deer as random individuals and family aggregates. Choccolocco deer generally bred during the first half of December, does had single fawns during initial and twins during subsequent pregnancies, and peak fawning occurred between mid-June and early July.

Conclusions. Low soil fertility and an overbrowsed range have resulted in low carrying capacity. Previous management practices on the Choccolocco Area have failed to remove annual deer surpluses. This has resulted in a deer population in excess of the present carrying capacity of about 2,000 deer. Either-sex hunting on the Choccolocco Area is recommended in order to remove excess deer before range damage becomes permanent or mass deer die-offs possibly result. The Choccolocco Area, with its many unique features, requires and justifies continued research in order to achieve sound deer management.

Reproductive behavior indicates that O. v. virginianus deer populations occur north of and O. v. osceola populations occur south of the Fall Line in Alabama.

Microfilm $2.50; Xerox $5.80. 117 pages.

STUDIES ON BLACK ROOT ROT OF PINE SEEDLINGS

(L. C. Card No. Mic 59-5683)

Charles S. Hodges, Jr., Ph.D.
University of Georgia, 1959

Supervisor: Dr. Julian H. Miller

Black root rot is a serious disease of slash and loblolly pines grown in southern forest nurseries. A survey showed that this disease is present in 3 nurseries in Georgia, and one nursery each in Alabama, Florida, North Carolina and Texas. The disease is characterized by necrosis of the lateral and tap roots and by enlarged

roughened areas on the tap root and larger laterals. Histological studies demonstrated that these areas were caused by multiplication and enlargement of the phelloderm cells and abnormal division of the phellogen. No mycelium was found in the proliferated tissues.

Sclerotium bataticola and Fusarium spp. were the only fungi consistently isolated from affected seedlings from all nurseries where black root rot was found. S. bataticola, F. oxysporum and F. solani, both alone and in combination, proved to be pathogenic to pine seedlings but only S. bataticola alone or in combination with the two species of Fusarium produced symptoms similar to those that occurred in the nurseries. However, disease symptoms produced in artificial inoculation studies were not as severe as those which were found in the nurseries. Further studies showed an increase in disease severity on seedlings inoculated with S. bataticola and F. oxysporum with increases in the soil temperature ranging from 21.1°C to 37.8°C. The increase in the severity of symptoms of black root rot on seedlings grown in naturally-infested soil with increasing temperature was also demonstrated, substantiating field observations that the disease is more severe during the summer when high soil temperatures prevail.

The production of indoleacetic acid in vitro by S. bataticola was demonstrated using paper chromatographic techniques. This compound was not detected in culture filtrates of F. oxysporum and F. solani. It is suggested that indoleacetic acid may be responsible for the proliferation of root tissues on seedlings affected by black root rot.

Soil fumigation with methyl bromide gave the best control of black root rot. Vapam gave almost as good control as methyl bromide but Mylone and ethylene dibromide (EDB) were only partially effective. DD was ineffective.

Methyl bromide, Vapam and steam treatment of soil initially lowered the population of fungi, bacteria and actinomycetes to a small percentage of the original population. The population of fungi and bacteria and actinomycetes increased sharply in the steam-treated soil within a week following treatment and continued to rise until it reached a peak in 3 weeks of 824 per cent of control for fungi and 1418 per cent for bacteria and actinomycetes. Similarly, the population of bacteria and actinomycetes in the methyl bromide and Vapam treatments reached peaks in 3 weeks at 1639 per cent and 1907 per cent of control respectively. The populations of all groups of organisms rapidly declined and leveled off at 200 to 300 per cent of control after about 2 months. The fungus population in the methyl bromide treatment slowly increased and reached 100 per cent of control after 3 months, while that of the Vapam treatment reached only 31 per cent of control after 4 months.

Trichoderma viride was the dominant fungus recolonizing the soil following fumigation with methyl bromide and in many instances was the only fungus isolated. Several species of Aspergillus and Penicillium made up the majority of the fungi recolonizing the soil fumigated with Vapam. Aspergillus fumigatus, Penicillium jenseni and T. viride were present in almost equal numbers following steam treatment.

Populations of all organisms were reduced only slightly by EDB and no change in the species of fungi present was noted following treatment with this material.

Microfilm $2.50; Xerox $6.20. 127 pages.

DWARF MISTLETOE AND ITS EFFECT UPON THE GROWTH OF LARCH AND DOUGLAS FIR IN WESTERN MONTANA

(L. C. Card No. Mic 59-5472)

William Rogers Pierce, Ph.D.
University of Washington, 1959

Chairman: David R. M. Scott

Dwarf mistletoes are intolerant, dioecius seed plants belonging to the Loranthaceae family. Five species, Areceuthobium pussillum, A. americanum, A. douglasii, A. vaginatum, and A. campylopodum have been recognized in North America. All of them are restricted to coniferous hosts.

The aerial portions of the plant are small, not exceeding 2 1/2 inches in length, and contain very little chlorophyll. They persist for only a short time, varying with the species, and their primary purpose seems to be reproduction. Pollination is by insects and the small dense seeds are dispersed by mechanical propulsion.

The greater portion of this pest lies within the host tree, forming the endophytic system. Infection usually originates on the younger branches of the host and persists as long as that part of the tree remains alive.

Stands infected with this parasite do not begin to produce the volume or quality of products of which they are capable. This is the result of a reduction in the growth rate, of poorer form, distortion of grain, larger knots, and higher mortality in the infected trees. In addition there is a reduction in the size of the viable seed crop and infected seedlings are usually unable to reach merchantable size.

Merchantable size larch and Douglas fir with less than 33 per cent of their crown infected with mistletoe will have about 14 per cent slower basal area growth than a healthy tree. Trees of the same species with over 60 per cent of their crown infected with the parasite can have their basal area growth reduced as much as 68 per cent.

Because of the magnitude of the growth losses incurred from this parasite it must be controlled before the production of timber in the future can become an economic possibility for those stands now infected.

Microfilm $2.50; Xerox $7.40. 158 pages.

A COMPARISON OF FOREST ECOLOGICAL SAMPLING TECHNIQUES WITH THE USE OF A KNOWN POPULATION

(L. C. Card No. Mic 59-6649)

Theodore William Sudia, Ph.D.
The Ohio State University, 1954

An eleven acre portion of Blacklick Woods, a sixty acre forest tract, was surveyed and every tree 4 inches or over in diameter at breast height was mapped.

Blacklick Woods is a park of the Metropolitan Park District of Columbus, Ohio, located 3/4 mile east of the intersection of Livingston Avenue and Brice Road in middle eastern Franklin County, Ohio.

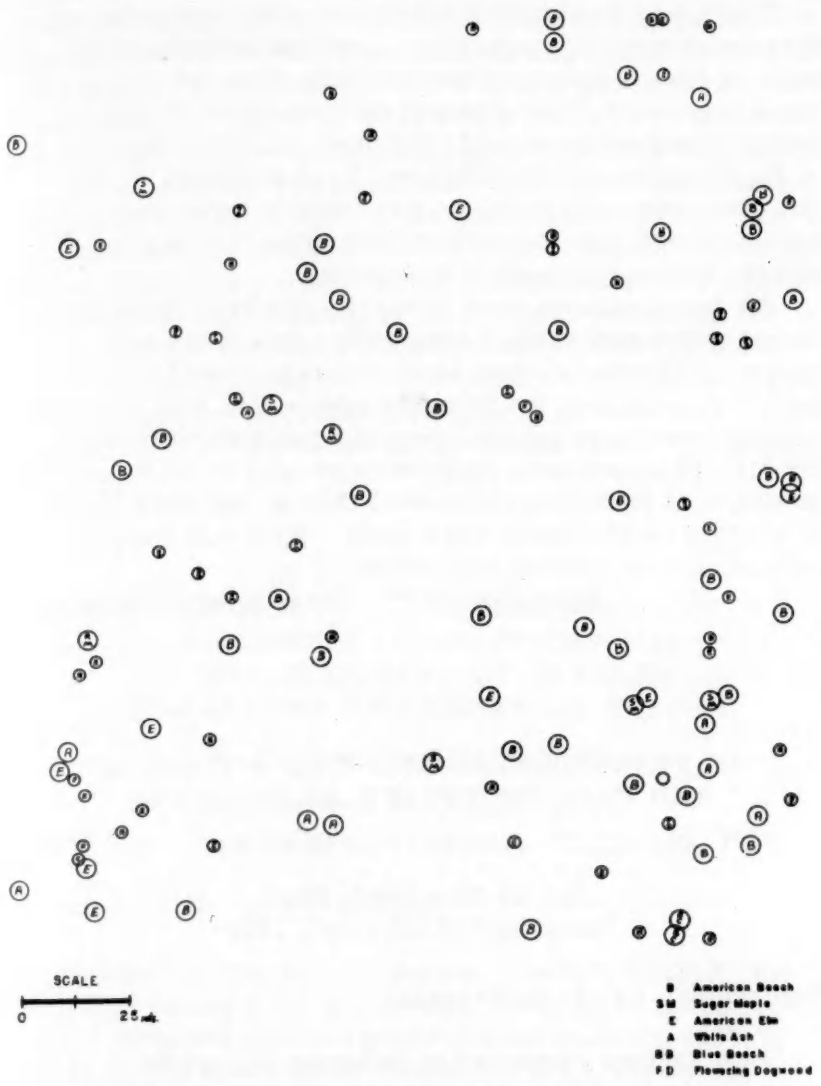


Fig. 1. A Typical Section of the Study Area

The tree vegetation of Blacklick Woods is Swamp Forest interspersed with Beech-Maple, and the dominants in the Swamp Forest community are American Elm (Ulmus americana L.), White Ash (Fraxinus americana L.), and Red Maple (Acer rubrum L.). The dominants of the Beech-Maple community are American Beech (Fagus grandifolia Ehrh.) and Sugar Maple (Acer saccharum L.).

Figure 1 is a reproduction of a portion of the map. The most prominent tree is American Beech. However, the interspersion of Elm is also illustrated in this figure.

Sampling trials utilizing sampling methods currently in use in forest ecological work were conducted using the map as a known population.

The methods used to sample the map population were: (1) plotless variable radius method;[1] (2) random pairs method;[2] (3) the 4-yard quadrat; (4) the 10-yard quadrat; and (5) four transects, two of which crossed the width, and two of which crossed the length of the area.

Each sampling method was used to estimate basal area per acre and stems per acre of the total population for American Beech, Sugar Maple, American Elm, White Ash and Red Maple individually, and for all other species as a single category. These values were compared to the true values which were derived from the map and the field record.

The estimates derived from each sampling method were compared to the true values in two ways. (1) Each method as a whole was compared to the array of true values as a whole. The data were transformed to percentages, which gave the effect of replication, and the t-test for paired comparisons was used.

Random pairs sampling was the only method which, when compared to the true values, yielded a smaller t than t at the 5 per cent level of significance for both basal area per acre and stems per acre. All others yielded values of t greater than t at the 5 per cent level. The 4-yard quadrat was the least efficient, with the others falling in between.

(2) Each item of the individual sampling methods was compared to the corresponding true value. The transformed data were used for this analysis also. A t-test for the difference between an observed and expected proportion was used.

No method yielded a t value less than t at the 5 per cent level for Beech. Again random pairs proved to be the most efficient on the basis of the comparison of the methods. Itemwise for estimates of basal area per acre they may be rated in the following order: (1) random pairs, (2) 10-yard quadrat, (3) plotless variable radius method and transect 8 x 304 yards, (4) transect 4 x 95 yards, (5) 4-yard quadrat and transect 4 x 95 yards.

They may be rated in the following order for estimates of stems per acre: (1) random pairs, (2) transect 8 x 304 yards, (3) transect 4 x 95 yards, (4) transect 4 x 278 yards, (5) transect 8 x 120 yards and plotless variable radius method, (6) 4 yard and 10 yard quadrats.

It must be thoroughly understood that these ratings apply particularly to the study area and generally to similar deciduous forest communities disposed over similar terrain. As Shanks[3] pointed out, the plotless variable radius worked best for him in the Spruce-Fir communities of Tennessee. The random pairs method did not work well there. This leads to the inference that sampling methods devised in one particular type of forest community may not yield valid information in another, especially if the sampling technique is empirically tested and altered to suit one particular forest community structure.

The quadrat and transect methods of sampling may not yield good estimates of forest community characteristics because the trees are secondary to the unit area of the sampling method. That is, area is the unit sample, and the trees per sample unit area may vary widely. This may not take into account the peculiarities of the distribution of the tree population in space and therefore may lead to biased results. This factor may explain why Bordeau[4] failed to get appreciably different results with stratified random and selective quadrat sampling.

Microfilm $2.50; Xerox $3.00. 39 pages.

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AGRICULTURE, PLANT CULTURE

COLD HARDINESS OF PASTURE GRASSES OF FLORIDA AS INFLUENCED BY NITROGEN FERTILIZATION

(L. C. Card No. Mic 59-6095)

Leonard Sypret Dunavin, Jr., Ph.D.
The University of Florida, 1959

An experiment was conducted on the Agronomy farm at Gainesville, Florida from 1957 until 1959 to compare the influence of two rates of nitrogen fertilization on the cold hardiness of Pensacola Bahiagrass and Pangolagrass. The rates were 100 and 400 pounds of nitrogen per acre per year. Cold hardiness was studied in 1957-58 through the use of measurements of the specific conductivity of tissue extracts.

Greenhouse survival studies were carried on in 1957-58 to provide a means of checking the validity of the results of the conductivity experiments.

Statistical analyses were made of the data obtained in 1958-59.

Total nitrogen content was determined for the samples of grass which were tested for hardiness in 1958-59 and for the forage samples obtained in the summer of 1958.

Climatic data were collected at the weather station located on the Agronomy farm and microclimatic data were obtained in the experimental plots. Vertical levels of measurement included the soil surface, three inches in the air, twelve inches in the air, and five feet in the air.

Forage yield data were obtained in the summers of 1957 and 1958 and for the first cutting in 1959.

In Bahiagrass, cold hardiness was generally greater at the 400 pound level of nitrogen during both years. Pangolagrass generally appeared to exhibit greater hardiness at the 100 pound level during both years. The conductivity measurements show that apparently both grasses were more cold hardy during the 1957 season than during the 1958 season.

The 1958-59 season was divided into six periods of three observation dates each, and per cent of total conductivity was used as the indicator of cold hardiness. Periodic differences were observed to exist. Following periods of low temperatures, there was some tendency for the grasses to exhibit degrees of cold hardiness at the two fertility levels in each grass which approached equality.

Bahiagrass was more cold hardy at either fertility level than Pangolagrass at either fertility level. More fluctuations between fertility levels as to degree of cold hardiness were noted in Pangolagrass. Wider spreads between fertility levels as to degree of cold hardiness were observed in Bahiagrass.

Greenhouse survival studies produced good agreement with the results obtained from conductivity studies.

Nitrogen content was not correlated with cold hardiness.

Yield data indicated that winter injury was more severe in Pangolagrass at the 400 pound level of nitrogen and that no differences existed between the fertility levels as to winter injury of Bahiagrass. During the more severe winter of 1957-58, Pangolagrass was more heavily damaged than in the 1958-59 winter while the opposite was true of Bahiagrass. Bahiagrass was not damaged to any large extent in either winter.

There was no correlation between cold hardiness and average minimum temperature, average mean temperature, or lowest minimum temperature when the temperatures used were those obtained between dates of experimental observation of cold hardiness, except in the case of Pangolagrass at the 400 pound level of nitrogen. In this later case a correlation was found between cold hardiness and both the average minimum temperature and the lowest minimum temperature.

Air temperatures were generally colder at night three inches above soil surface than at five feet above soil surface. The twelve-inch level was also found to be colder at night than the five-foot level. Soil surface under a grass cover was generally considerably warmer than the air. Fluctuations in range were greater at the three-inch level and at the twelve-inch level than at the other levels at which measurements were made. Wind was found to reduce temperature stratification.

Microfilm $2.50; Xerox $5.80. 120 pages.

AN EXPERIMENTAL STUDY OF POTASSIUM AND CALCIUM UPTAKE BY SOYBEANS

(L. C. Card No. Mic 59-5638)

Robert Gale Gast, Ph.D.
University of Missouri, 1959

Supervisor: Dr. E. R. Graham

Some factors suggested to influence the uptake of cations by plants and to characterize optimum conditions for plant nutrition were studied by growing young soybeans in carefully controlled solutions. The influence of activity levels of potassium and ratios of potassium to calcium expressed as the energy of exchange of potassium for calcium were studied by growing soybean plants in solutions having a wide range of potassium activities and ratios of potassium to calcium. The influence of the free energy change in cation exchange reactions between plant roots and substrate media was studied by using various substrate anions. The bicarbonate, chloride and acetate ions were used. As the substrate solutions contained only calcium and potassium as the acetate, chloride or bicarbonate, it was necessary to spray the remaining essential elements on the leaves. Plant response was measured in terms of dry weight, uptake of potassium and calcium and the total content of amino nitrogen in the leaves of the plants.

From the results it was obvious that the optimum value of energy of exchange was dependent on the activity of potassium and in turn the optimum level of potassium activity was dependent on the energy of exchange but to a less extent. From this it would seem that it would be very difficult to define an optimum energy of exchange in soils and would have to be determined empirically by some conventional methods. Quite possibly wide groups of soils might be similar enough that optimum ranges of both potassium levels and energy of exchange might be defined within rather narrow limits.

The free energy change in cation exchange reactions between substrates and root surfaces was found to have a decided influence on the uptake of potassium and calcium by plants. This effect was found at comparatively high

levels of potassium and calcium and became more pronounced as the level of these cations was reduced. From this it would seem that this could be a powerful factor in controlling ion uptake in soils where the activity levels of cations are largely undefinable but are no doubt very small.

Although there was significant variation in the concentration of amino nitrogen in the plants grown in the experimental substrates, it followed no logical pattern and could not be interpreted in light of the experimental treatments.

While the molar ratios of activities of potassium to calcium in the medium varied between 0.014 to 68.2, the ratios in the plant varied only from 2.0 to 9.5 in the plants, giving selection coefficients ranging from less than 1 to as high as 214. Microfilm $2.50; Xerox $5.80. 120 pages.

THE EFFECT OF LIGHT, MOISTURE AND INTER-SPECIES COMPETITION UPON THE ESTABLISHMENT OF ALFALFA, LADINO CLOVER AND BIRDSFOOT TREFOIL.

(L. C. Card No. Mic 59-5667)

Dewayne Everett Gilbert, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dr. Iver J. Johnson

An investigation was conducted on well fertilized Colo Silt Loam during a hot dry season, 1956, and a season of normal temperatures and above normal rainfall, 1957, to determine the effect of the companion crop, weeds and irrigation on the establishment of alfalfa, Ladino clover and birdsfoot trefoil. The 1957 seedings were sampled twice in 1958 to determine the carry-over effect of the treatments imposed in 1957. Plant population, legume and weed dry matter production, grain and straw plus chaff yields and weight per 1000 kernels were determined during the year of establishment. Legume population and legume and weed dry matter yields were determined in 1958 for the first harvest season of the 1957 seeding.

While the effect of the companion crop and weeds, grown separately, reduced legume stands and yield, the effect was not additive when the companion crop and weeds were grown together.

The companion crop reduced weed dry matter production by 57% in the dry season and 72% during the season of above normal rainfall.

Alfalfa and birdsfoot trefoil stands and dry matter production were lower, in 1958, where inter-species competition existed in 1957. With Ladino clover, the stoloniferous growth habit compensated for the adverse effects of inter-species competition during establishment.

Weeds, as a source of inter-species competition had no carry-over effect in the first harvest season with all legumes.

Irrigation had no effect on legume stands and dry matter production during legume establishment. Therefore it is hypothesized that light was the growth factor limiting plant population and subsequent yields. Irrigation increased weed growth only during the dry season and legume dry matter production only in the absence of all inter-species competition.

Grain and straw and chaff yields were not affected by either irrigation or weeds. An irrigation by weeds interaction reduced grain yields in both seasons and straw and chaff yield during the dry season.

Weight of oat grain was increased due to irrigation during the dry season and was not affected during the season of above normal rainfall. Weeds caused no significant change in seed weight in either season.

Alfalfa, Ladino clover and birdsfoot trefoil were seeded in moist soil in the greenhouse, in September 1958, and were subjected to light intensities of 100, 50, 25 and 10% of normal greenhouse light for seven weeks. Irrigation was applied to one half the area of each light intensity.

Decreasing light intensity resulted in decreased growth and development of root and above ground structures of all legumes tested. In general, irrigation resulted in highly significant increases in dry weight under all intensities but when the effect of irrigation was tested at each light level, only at 50% intensity was the effect of irrigation significant.

Nodulation of birdsfoot trefoil was inhibited at 10% light intensity and was insensitive to irrigation or light intensity changes. Nodulation of Ladino clover was better than that of alfalfa and irrigation of both legumes resulted in increased nodule numbers.

Alfalfa appeared to be the most tolerant to inter-species competition and to adverse growing conditions. Ladino clover exhibited more tolerance than birdsfoot trefoil. Microfilm $2.50; Xerox $5.80. 116 pages.

BORON-ALUMINUM RELATIONSHIPS IN THE SOIL AND IN PLANT UPTAKE

(L. C. Card No. Mic 59-6100)

Charles Carpenter Hortenstine, Ph.D.
The University of Florida, 1959

Four outdoor tests were conducted in 3- and 5-gallon glazed earthenware lysimeters. The tests were designed to study the effect of various levels of aluminum and boron applied to the soil on the yield and the aluminum, boron, and calcium contents of the indicator plants. The plant species used in these tests were sunflowers, rutabaga turnips, lettuce, and Louisiana S-1 white clover. The sunflower plants were fertilized with aluminum sulfate at rates of 0, 10, 20, and 40 pounds of aluminum per acre in combination with boric acid at rates of 0, 0.5, 1.0, and 2.0 pounds of boron per acre. The other three crops were fertilized at rates of 0, 20, and 40 pounds of aluminum per acre in combination with 0, 1, and 2 pounds per acre.

Boron deficiency symptoms developed in the rutabagas, lettuce, white clover, and the sunflower plants in the two greenhouse tests using varying levels of boron. The addition of boron to the growth media resulted in yield increases in these five crops and there was an increase in the uptake of boron. Aluminum added to the soil resulted in decreases in the yield of lettuce and clover.

Two greenhouse tests were designed to study the effect of varying levels of aluminum and boron in nutrient solution culture on the yield and the aluminum, boron, and calcium contents of sunflower plants. In the first of these tests aluminum and boron salts were added to the nutrient

solution at levels of 0, 0.5, and 1.0 ppm. as the elements. In the second test rates of 0, 1.0, and 2.0 ppm. of aluminum and rates of 0, 0.5, and 1.0 ppm. of boron were used.

The plant weights and heights were greatly increased when added boron was present in the nutrient solution. Aluminum had no effect on the uptake of boron; however, there was a decrease in the absorption of aluminum by the plants in the presence of added boron. Boron had the effect of increasing the calcium uptake by the plants in the first of the two tests.

In another greenhouse test the effects of varying levels of aluminum added to nutrient solution on the yield and the aluminum, boron, and calcium contents of sunflower plants were studied. Rates of 0, 2, 4, 6, 8, 10, 12, 14, and 16 ppm. of aluminum were added with the boron level at 1 ppm. There was a highly depressive effect from increased levels of aluminum in the yield and height of the sunflower plants and in the uptake of calcium by the plant roots. Aluminum was found to accumulate in large amounts in the roots of the sunflowers as the rates of added aluminum increased.

A survey was conducted in central and southern Florida in which soil and tomato and palmetto leaf samples were collected from several representative soil types. Aluminum, boron, and calcium analyses were made of the soils and leaves in order to determine the extent of correlation among the three elements. A significant correlation was found to exist between the boron and aluminum contents of the cultivated soils sampled and between the calcium and aluminum contents of the cultivated and uncultivated soils. The amounts of boron and calcium were found to decrease in the soil as the amount of aluminum increased.

Microfilm $2.50; Xerox $5.80. 117 pages.

THE EFFECT OF NUTRIENT LEVELS IN NUTRIENT CULTURES ON THE TRANSLOCATION OF FOLIAR APPLIED NUTRIENTS

(L. C. Card No. Mic 59-3978)

David D. Neher, Ph.D.
Utah State University, 1959

Major Professor: Dr. R. L. Smith

Greenhouse work was performed in 1956 using individual variables of pH, phosphorus, copper, manganese, zinc, iron, calcium nitrate, and magnesium sulfate in the nutrient solution in which red kidney beans were grown to determine their effects on the translocation of foliar applied ferric chloride and DTPA-Fe. The pH of 7.5 enhanced the translocation of foliar applied iron over pH 5.0. The foliar applied DTPA-Fe enhanced the translocation of iron over the foliar applied ferric chloride when compared to the standard which received low phosphorus and iron in the nutrient solution. No interactions nor metal treatments gave significant effects on translocation. Data were quite variable, possibly due to the many uncontrolled environmental factors.

During the summer of 1957 a plant growth room was completed. Initial experiments proved leaf flap method of making foliar applications of phosphorus to beans was superior to the puddle method. Little difference was observed when used on corn. Steam girdling experiments also demonstrated that movement out of the leaf was by way of the phloem. Experiments were also conducted to determine the effect two different levels of phosphorus, copper, manganese, zinc, iron, calcium nitrate, and magnesium sulfate in nutrient cultures had on the absorption and translocation of the foliar applied phosphoric acid in corn. High levels of phosphorus, copper, and zinc inhibited the translocation of the foliar applied phosphorus while high levels of manganese, calcium nitrate, and magnesium sulfate enhanced it.

During the summer of 1958 work was performed in a plant growth room to study element effects of the greenhouse work of 1956. Only pH 5.0 was used with ferric chloride as the foliar application. High levels of phosphorus, manganese, zinc, iron, and calcium nitrate significantly inhibited the translocation of iron over the standard which received low levels of phosphorus and iron in the nutrient solution.

Microfilm $2.50; Xerox $4.00. 73 pages.

AN EVALUATION OF QUANTITATIVE METHODS FOR MEASURING COLD HARDINESS OF CITRUS SEEDLINGS

(L. C. Card No. Mic 59-6104)

Gurdev Singh Nijjar, Ph.D.
The University of Florida, 1959

During these investigations quantitative methods for the measurement of cold hardiness of plants were evaluated with a view to finding a reliable method suitable for citrus seedlings. The experiments comprising this study were conducted under controlled climatic conditions. One cold chamber and two growth chambers where temperature, light, humidity and nutrition could be controlled, were constructed for this purpose.

Eight-month-old citrus seedlings of Key lime (Citrus aurantifolia Swingle), Rough lemon (Citrus limon L.), and sour orange (Citrus aurantium L.) were randomly selected and were grown in one of the growth chambers for four weeks at 78°F. The seedlings were then randomly divided into groups and exposed to hardening temperature (38°F.) for ten days and/or to freezing temperature (23°F.) for three hours.

After the seedlings had received their respective temperature treatments, the following criteria of possible cold hardiness were tested: (1) Electrical conductivity of tissue extract; (2) electrical conductivity of intact seedlings; (3) estimation of water-soluble proteins; (4) plasmolysis test; and (5) actual freezing test.

The results showed that the electrical conductivity method using the tissue extract as well as the intact seedlings, did not satisfactorily measure the cold hardiness of seedlings of different species of citrus. The estimation of water-soluble proteins also failed to show any correlation with the corresponding cold hardiness of the seedlings.

In spite of very careful control of uniformity of bark sections and the timing of various operations in the

process, the plasmolysis test failed to yield reliable data to form the basis for a quantitative measure of the cold hardiness of citrus seedlings.

Actual freezing tests, in which the seedlings were exposed to the freezing temperatures, were found to be the most reliable for measuring cold hardiness. The recovery values obtained by these tests agreed favorably with the generally accepted degree of cold hardiness of each of the citrus species under study.

The actual freezing tests showed that previous exposure to constant, low, above-freezing temperature (38°F.) reduced the cold hardiness of seedlings. A high-day temperature (78°F.) alternating with a low-night temperature (32°F.) was better in inducing cold hardiness than either high or low constant temperatures. These tests further showed that the length of day had no measurable effect on the cold hardiness in either high or low constant temperature conditions. In the case of alternating high-day and low-night temperatures, the length of day was directly proportional to the degree of cold hardiness induced in the citrus seedlings.

Microfilm $2.50; Xerox $5.00. 99 pages.

THE INFLUENCE OF pH LEVEL AND SOIL PHOSPHORUS ON THE AVAILABILITY OF SOIL BORON AND MANGANESE TO PLANTS

(L C. Card No. Mic 59-5686)

Norwood Rufus Page, Ph.D.
University of Georgia, 1959

Supervisor: Dr. Harold D. Morris

Virgin Norfolk and Dunbar soils were treated with 200, 1800, and 3600 pounds of P_2O_5 per acre in a greenhouse experiment. Within each phosphorus level, one-third of the pots were adjusted to pH values of 5.0, 6.0, and 7.0, respectively. Sunflower, snapbeans, and oats were used to evaluate the effect of the varying phosphorus rates and pH levels on the availability of both residual and applied boron and manganese.

Both increasing the soil pH and raising the phosphorus rate decreased the plant uptake of residual boron to sunflower and both residual and supplemental manganese to snapbeans, oats, and sunflower. The greater yield response to boron was at the high phosphorus levels and a soil pH of 7.0. Phosphorus rates had no effect on the availability of supplemental boron and the availability of supplemental boron increased as the pH was raised.

A similar greenhouse experiment was set up with soils from selected plots of a long term fertility experiment having varying levels of available soil phosphorus to determine the effect of residual soil phosphorus at pH levels of 5.0, 6.0, and 7.0 on the availability of both residual and applied boron and manganese to plants.

Increasing the phosphorus level in the soil over a long period of time did not affect the uptake of either residual or applied boron by sunflower. In both experiments, boron applications decreased the plant uptake of phosphorus.

In this experiment, the availability of the residual manganese to plants increased directly with the level of soil phosphorus; however, the availability of supplemental manganese decreased as the level of soil phosphorus increased. In both experiments, raising the soil pH was more effective than high phosphorus levels in reducing the availability of soil manganese to plants. At pH 5.0, supplemental manganese greatly increased the concentration of manganese in plants, but at pH 7.0, it had very little effect.

In lysimeter studies, phosphorus applications up to 4,000 pounds of P_2O_5 per acre decreased the amounts of boron leached from the soil. The quantity of manganese leached from the soil decreased as the phosphorus level increased.

The water-soluble boron content, pH, acid-soluble phosphorus, and organic matter content of twelve soils were compared to the age at which sunflower plants exhibited boron deficiency symptoms and to yield response to supplemental boron. The water-soluble boron content of the soil was the only value of the factors tested that could be used to predict plant response to supplemental boron. Microfilm $2.50; Xerox $5.80. 119 pages.

SOME EFFECTS OF COMPETITION BETWEEN ALFALFA AND SORGHUM OR CORN FOR LIGHT, MOISTURE AND NUTRIENTS.

(L. C. Card No. Mic 59-6512)

Walter O'Daniel Scott, Ph.D.
Purdue University, 1959

Major Professor: Fred L. Patterson

Studies were conducted at Urbana, Illinois, and Lafayette, Indiana, to determine some of the effects of competition between alfalfa and grain sorghum or corn for light, moisture and nutrients.

Alfalfa, grain sorghum and corn growing alone and alfalfa growing in various combinations with grain sorghum and corn were subjected to four different periods of simulated drought. There was no significant evidence of serious competition between the crops for moisture.

Alfalfa and grain sorghum were grown alone and in combination at two levels of available soil potassium. The potassium content of the tops of the plants was determined when they were four and eight weeks of age. The only significant evidence of competition for potassium was observed in the alfalfa harvested at eight weeks of age. The total potassium in the tops of the eight-week-old alfalfa grown alone was greater than that in the tops of the alfalfa grown with sorghum. However, the percent potassium in the alfalfa did not drop below 1 percent and the greatest difference in total potassium occurred when grown in the soil with the highest level of available potassium.

Alfalfa was established as an intercrop between the rows of grain (short) sorghum, forage (tall) sorghum and corn in 1955, 1956 and 1957. The sorghum and corn companion crops were planted about the first of June each year and the alfalfa intercrop was planted either six weeks earlier, at the same time or three to four weeks later than the companion crops. In 1956, 40 pounds of nitrogen was applied at planting time to the companion crops in two of the four replications of each experiment.

The degree of competition between intercrop and companion crop was varied by planting the companion crop in 20-, 40- or 60-inch rows. The yield of the corn or sorghum, the number of alfalfa plants established and the height of the alfalfa were used as measures of competition.

More alfalfa plants were established between the rows of corn than between the rows of either kind of sorghum. However, grain (short) sorghum was a stronger competitor, especially when planted in 20-inch rows, to alfalfa than was forage (tall) sorghum.

The vigor of the alfalfa intercrop was least in the narrow rows of all companion crops. However, the height of the alfalfa growing between the 20-inch rows of grain sorghum was not as great as that growing between the rows of forage sorghum or corn.

Rainfall was considered adequate for the establishment of the alfalfa intercrop in each of the three years. Greenhouse experiments indicated that competition for moisture and potassium were not likely to be serious under the conditions of these experiments. Therefore, it is proposed that competition for light was the major cause for the differences in number of alfalfa plants established and in the vigor of the established alfalfa between the rows of short sorghum and corn. Light readings taken in late July with a Weston Master exposure meter show that the light intensity between 20- and 40-inch rows of short sorghum is only 25 to 50 percent as great as between the rows of corn planted in the same row widths. The effect of artificial shades, established in nonintercrop alfalfa in 1957, on the establishment and vigor of the alfalfa was comparable to that of the companion crops when planted in 20-inch rows.

Sorghum yields were greatest when the sorghum was planted in 20-inch rows. The effect of the presence of an alfalfa intercrop was dependent on the time the intercrop was planted. Yield of sorghum was materially reduced when the intercrop was planted before the sorghum. When the intercrop was planted at the same time or later than the sorghum, its presence did not materially influence the yield of the sorghum.

Microfilm $2.50; Xerox $5.60. 112 pages.

INVESTIGATION OF THE HEREDITARY CHARACTER, WOOLLY, IN THE TOMATO.

(L. C. Card No. Mic 59-5366)

Paul Richard Shilling, Ph.D.
The Ohio State University, 1952

A condition of profuse epidermal hair growth exists in some strains of the cultivated tomato, Lycopersicon esculentum Mill. This condition has been called both "woolly" and "woolly leaves" by Young and MacArthur.[1] The woolly character is lethal when homozygously dominant, and any plant manifesting the woolly character is a heterozygote. Upon selfing a woolly plant, a ratio of 2/3 woolly to 1/3 non-woolly plants had resulted.

Several aspects of the woolly character have been investigated in this problem:

1. Embryo sacs containing zygotes and embryos were examined in an attempt to ascertain whether irregularities in development in fruits of woolly and non-woolly plants resulted which could be attributed to the lethal action of the homozygous woolly character.
2. An attempt was made to determine whether there is a difference between fruits of woolly and non-woolly plants in the number and germination of normal-sized seeds.
3. Pollen mother cell smears of anthers from woolly plants were examined to determine whether a heterozygous deletion could be observed, indicating whether the woolly character is caused by a chromosomal deletion.
4. A more accurate description of the woolly character was attempted.
5. An investigation was made to determine whether tomato plants which have the longer epidermal hairs of L. hirsutum and the shorter epidermal hairs of woolly L. esculentum can be produced by a cross of these two species, indicating whether epidermal hair growth of these two species is governed by different genes.

Experimental Procedure

All field plantings of tomatoes were made at the vegetable farm of the Department of Horticulture and Forestry of the Ohio State University during the spring of 1951.

In a field planting, August 30-September 3, 1951, inclusive, flowers of both woolly and non-woolly plants were emasculated, self-pollinated, and immediately bagged. From September 3 to September 7, 1951, inclusive, fruits of both woolly and non-woolly plants were removed for sectioning. No fruits were removed less than 80 hours after pollination.

Serial sections of the fruits were examined for zygote and embryo development. Embryo sacs which contained normal or non-disintegrating zygotes or embryos and endosperm were counted, as were embryo sacs which showed disintegration of the zygote, embryo, or endosperm.

Ten fruits per plant were taken from 18 woolly plants and from 10 non-woolly plants in August, 1951. They were cut in half, and all normal-sized seeds were removed and counted. The resulting data were subjected to an analysis of variance.

Seeds were collected and saved from 10 fruits per plant of 10 woolly and 10 non-woolly plants in September, 1951. The fruits were not necessarily from the same plants from which seed counts were taken. Seeds from each plant were composited. In December, 1951, fifty seeds from each woolly and non-woolly plant were entered in germination tests on moist filter paper in Petri dishes. The resulting data were subjected to a Chi-square test.

Acetocarmine smears of pollen mother cells from anthers of greenhouse grown woolly plants were examined for evidence of a heterozygous deletion in the pachytene stage of meiosis. Since Barton[2] has shown that the woolly

locus is on the nucleolar chromosome, that chromosome was the only one examined in detail.

In a field planting, above-ground parts of woolly plants were visually compared with similar parts of non-woolly plants. Similar stems, anthers, and styles were examined microscopically and photographed.

Pollen from a Lycopersicon hirsutum plant was applied to emasculated flowers of woolly and non-woolly L. esculentum greenhouse-grown tomato plants during the early spring of 1951. Seeds from these crosses were planted the same year, and the resulting plants along with some L. hirsutum plants were transplanted to the field. During the summer of 1951 the plants were observed to see if any were superwoolly, i.e., had both the longer epidermal hairs of L. hirsutum and the shorter epidermal hairs of woolly L. esculentum.

Presentation of Results

There was little difference in the amount of zygote or embryo disintegration within the sampling range of the experiment (80 - 150 hours between pollination and removal of the fruits for sectioning). At the various stages of embryo development, the average per cent of disintegration of zygotes or embryos in embryo sacs of woolly and non-woolly plants varied from 17.1 $\pm$ 3.4 to 27.0 $\pm$ 5.4. This variation was not nearly great enough to be attributed to lethal action of the homozygous woolly character.

The mean number of normal-sized seeds per woolly fruit was 97 $\pm$ 4, and per non-woolly fruit 93 $\pm$ 4. The data indicate that the number of seeds per fruit from woolly and non-woolly plants was essentially the same. The mean percent germination of seeds from non-woolly plants was 77.6 $\pm$ 2.3, while from woolly plants it was 58.8 $\pm$ 1.4. A Chi-square test of the results based on an expected decrease in germination of seeds of woolly fruits of nearly 25 percent gave a value of 1.215, with a probability of .30 - .20. Since it is evident that there was nearly 25 percent less germination of seeds of woolly fruits, lethal action of the homozygous woolly condition possibly occurred between the 20-30 celled embryo stage and seed maturity (seed maturity being considered as the earliest stage at which tomato seeds can germinate, at least under normal conditions).

A few pollen mother cells were seen in which a heterozygous deletion possibly was demonstrable. However, many other cells were seen in which there was no evidence of a deletion. If a deletion did occur, it was too small to be observed.

Woolly plants are easily distinguished from non-woolly plants. Because of profuse epidermal hair growth on most above-ground plant parts, woolly plants appear grayish instead of a normal green color. The epidermal hairs on stems of woolly plants were no longer than those on stems of non-woolly plants but were merely more profuse. The woolly character was found to be expressed on most above-ground plant parts, which include leaves, stems, sepals, petals, parts of styles, and fruits. Below-ground plant parts were not investigated. Epidermal hairs were found only on the basal two thirds of the styles of both woolly and non-woolly plants, although epidermal hair growth was more profuse on styles of woolly plants. Epidermal hair growth on anthers of woolly plants was no more profuse than that on anthers of non-woolly plants.

"Superwoolly" plants were produced, indicating that epidermal hair growth of L. hirsutum and woolly L. esculentum is governed by different genes. The genes may or may not be alleles.

Microfilm $2.50; Xerox $3.00. 52 pages.

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THE DIGESTIBILITY OF GRASS STRAINS

(L. C. Card No. Mic 59-6419)

Frank Walter Sosulski, Ph.D.
State College of Washington, 1959

Supervisor: Dr. J. K. Patterson

This study was initiated to determine what effect differences in lignin content might have on the apparent digestibility of grass strains, species, and genera. In 1956 and 1957, large plots of Latar and S-143 orchardgrass, Manchar and Russian bromegrass, Alta fescue, and Amurense intermediate wheatgrass were harvested at the flowering stage of growth. The two latter forages were also harvested at heading in 1957. The forages were field-cured and fed to Hampshire wethers. Latin square designs were used in the digestion trials.

The relationship of the proximate analysis and lignin content of the forage to apparent digestibility and rate of consumption was determined statistically. The only forage constituent which showed a significant negative correlation with apparent digestibility in both the 1956 and 1957 digestion trials was the lignin content. The positive correlation between the percentage of protein in the forage and apparent digestibility was significant in the 1956 digestion trial; crude fiber content showed a significant negative correlation with digestibility in 1957. By methods of partial correlation it was found that in each year any relationship between crude fiber content and apparent digestibility of energy was due solely to the high positive correlation between crude fiber and lignin content.

The orchardgrass strains were found to have a consistent significant difference in only one chemical constituent--lignin. For the prediction of apparent digestibility in strain comparisons, it is recommended that a regression equation of digestibility of energy on lignin content be used.

Significant differences in protein and lignin content were found in the species and genera comparisons. A

multiple regression of digestibility of energy on lignin and protein content proved to be the best prediction of apparent digestibility for these forages.

The rate of consumption of the forages by wethers was positively correlated with protein content and negatively correlated with crude fiber and lignin content. Although no correlation was found to be significant in the two years of the study, it was apparent that these chemical constituents are related to rate of consumption in the same manner as they are related to digestibility. Selection for high apparent digestibility among grasses would usually result in forages high in rate of consumption. Differences among the forages harvested at flowering in rate of consumption were not large.

In the 1956 digestion trial, Alta fescue and Amurense intermediate wheatgrass were lowest among the forages in apparent digestibility and rate of consumption. Harvesting these grasses at heading in 1957 substantially improved their digestibility. The rate of consumption of Alta fescue, however, was not improved by the earlier date of cutting. Daily intake of Amurense intermediate wheatgrass averaged over 3,000 calories per wether when harvested at heading, compared to less than 2,000 calories per day at flowering.

Among the grasses harvested at flowering, Russian bromegrass was highest in apparent digestibility and rate of consumption in each year of the study.

Microfilm $2.50; Xerox $3.00. 56 pages.

FACTORS CONTRIBUTING TO THE SUPERIOR YIELDING ABILITY OF COMPACT SEMIDWARF MAIZE AT HIGH POPULATION

(L. C. Card No. Mic 59-6517)

Walter Frank Sowell, Ph.D.
Purdue University, 1959

Major Professor: A. J. Ohlrogge

Laboratory and field experiments were conducted to determine the factor or factors responsible for the high yielding ability of compact semidwarf plants at high populations. Previous experiments have shown that compact plants at high populations produced a larger yield of grain than did Hy normal plants at any population tested. The two inbreds had roughly comparable genotypes except for the loci conditioning plant size.

In the field experiment plants were grown at a population of 52,000 plants per acre, with high rates of fertilization, and under adequate moisture conditions.

Gibberellic acid treatments resulted in an increased elongation of compact seedlings in controlled environmental conditions and in the greenhouse, but had no effect on plants in the field.

Vegetative dry weight accumulation was essentially the same for both Hy normal and compact inbreds in the field prior to flowering. However, the vegetative growth rate of Hy normal plants was greater during flowering than at any other stage of development. Conversely, compact plants ceased to grow vegetatively at flowering.

There were no differences in fructose content (free fructose plus that released on sucrose hydrolysis) of the two inbreds during the early vegetative stage of development. Immediately prior to tasseling however the fructose content of Hy normal stems was higher than those of the compact plants; this difference disappeared at silking. The sugar content increased in both inbreds as the plants developed.

Sixty two percent of the Hy normal plants remained barren of grain; only five percent of the compact plants failed to produce grain. The results indicated that Hy normal plants at high populations cannot support rapid vegetative growth and ear shoot development simultaneously, although Hy normal plants accumulated large quantities of sugar in the stem in the late stage of development.

Chromatograph and biological tests with tassel extracts indicated that compact inbred tassel material produced less growth promoting substances or more inhibitors than Hy normal tassel material.

The results suggest that cessation of vegetative growth at flowering, resulting from the absence of growth promoting substances or the presence of an inhibitor, was the major factor responsible for compact developing an ear on each plant, and the superior yield at high populations. Photosynthates in compact plants were available for ear shoot growth and development, as vegetative growth had ceased. The results also indicated that the factor or factors responsible for cessation of compact vegetative growth at flowering is closely associated with the male inflorescence. Microfilm $2.50; Xerox $4.80. 91 pages.

THE EFFECT OF SOIL REACTION ON THE AVAILABILITY OF NATIVE AND APPLIED PHOSPHORUS

(L. C. Card No. Mic 59-5688)

Frank Harry Thomas, Ph.D.
University of Georgia, 1959

Supervisor: H. D. Morris

Samples from six soil series (A and B horizon) were taken. Cecil, Red Bay, and Tifton soils (A horizon) were placed in one-gallon cans lined with polyethylene in the greenhouse; pH adjusted to 5.5, 6.5, and 7.5; and phosphate treatments applied. Oats were grown on these soils and two successive harvests made. The yield and percent plant phosphorus were determined. Also, oats were used as the test crop on Cecil soil in the short-term nutrient absorption by plants study. The soil treatments were the same as in the conventional greenhouse study. The yield of oat forage was obtained and plant samples were analyzed for phosphorus. Soil samples were taken and analyzed for "available" soil phosphorus using three extracting solutions.

All six soil series were treated with phosphate and had the pH adjusted to 5.0, 5.5, 6.0, 6.5, 7.0, and 7.5 using different sequences of applying phosphate and adjusting the pH value. The pH and phosphorus extracted by

acid- and alkali-solutions were determined approximately six months later.

Liming Cecil, Red Bay, and Tifton soils to a pH value of 6.5 increased the yield and percent phosphorus of oats. Liming increased the availability of native soil phosphorus in Tifton and Cecil soils as measured by yield and percent phosphorus in oats. This increase was not obtained in chemical extractions of the soil.

Adjusting the soil pH 60 days before adding phosphate increased the availability of applied phosphorus in Cecil, Red Bay, and Tifton soils under greenhouse conditions. In general, applying phosphorus and adjusting the pH at the same time was as good as adjusting the pH 60 days before applying phosphate.

Dicalcium phosphate was a more efficient source of phosphorus than concentrated superphosphate for oats on Cecil soil as measured by yield and percent plant phosphorus in the conventional greenhouse study. There was no difference in these phosphorus sources when evaluated by the short-term nutrient absorption by plants method.

The total percent phosphorus in oats grown on Cecil soil in the conventional greenhouse study was highly correlated with the percent phosphorus in oats grown in the short-term nutrient absorption by plants study but the corresponding yields were not correlated. There was no correlation between the phosphorus extracted from soils utilized in the investigation by alkali or soil test extracting solutions and soil pH. The Truog extracting solution was significantly correlated with soil pH; however, this correlation was low.

Microfilm $2.50; Xerox $5.60. 113 pages.

THE EFFECT OF FOLIAR APPLIED NITROGEN, PHOSPHORUS, AND POTASSIUM ON THE GROWTH AND COMPOSITION OF CORN.

(L. C. Card No. Mic 59-6642)

Winfred Thomas, Ph.D.
The Ohio State University, 1954

Introduction

A great deal of work has been done in recent years in applying nitrogen to the foliage of plants with varying degrees of success. Much less has been done with phosphorus, except when used in combination with the other major fertilizer elements, and very little work has been done where potassium was applied singly to the foliage of plants. Most of the experiments with foliar sprays were conducted under field conditions and consisted primarily of spraying a solution of the material on the plant with a power sprayer. As a result of this technique, a great deal of the fertilizer eventually reached the soil where it could have been absorbed by the roots. In the final analysis, no definite conclusions could be drawn relative to the absorption efficiency of the leaves versus roots. The objectives of the experiment were: (1) to determine the response of field crop plants to foliar application of nitrogen, phosphorus, and potassium; (2) to compare the effectiveness of foliar applied fertilizer materials with fertilization of the rooting medium; (3) to compare the relative rate of absorption of nitrogen, phosphorus, and potassium and their effect on the composition of the plant when applied to the foliage and rooting medium.

Materials and Methods

Corn plants growing in greenhouse soil beds were sprayed with various molar concentrations of urea ($CO(NH_2)_2$), potassium chloride (KCl), and monobasic potassium phosphate (KH_2PO_4), to determine the maximum salt concentration which could be applied without injury to the plant. The maximum concentration appeared to be approximately 0.1 molar solution of each compound. Therefore 3 to 5 grams of both urea and potassium chloride and 8 to 10 grams of monobasic potassium phosphate per liter of water, with a commercial wetting agent, were used in the following experiments:

Corn was grown in 3 gallon glazed pots which contained washed quartz gravel. An automatic irrigation system was used in which a small low pressure Crowell-type air pump forced the culture solution contained in five gallon distilled water bottles into the gravel. The cycles of irrigation were 5 to 6 times a day. The corn was irrigated with rain water until 7 to 10 days after germination, at which time the respective stock solutions were added to provide the desired concentration of the various elements.

In order to determine the effect on corn of foliar application of urea, potassium chloride, and monobasic potassium phosphate when applied singly, the pots in which the corn was grown were covered with aluminum foil and then sealed with paraffin to prevent contamination. The various solutions were then applied with a 3 gallon compression sprayer operated at 20 to 25 pounds of pressure.

A comparison of the growth of corn when the same volume of the respective solutions were applied to foliage and rooting medium was made possible by delivering the solution from a 1 milliliter pipette into the funnel formed by the leaf blades at the growing tip of the corn plant. After the writer ascertained the total volume applied to the foliage of plants in one pot in this manner, he added the same volume to the rooting medium of another. This procedure was followed for each replication.

Discussion and Results

An experiment was carried out to determine the effect of foliar application of urea on corn. Four replications of the following treatments were used: (A) received only an initial 5 p.p.m. nitrogen in the culture solution; (B) received an initial 5 p.p.m. nitrogen in the culture solution plus urea solution (5 g./l.) applied to foliage; (C) received an initial 100 p.p.m. nitrogen in the culture solution.

All pots were covered with aluminum foil and sealed with paraffin to prevent contamination. The corn receiving treatment B was sprayed six times with a 3 gallon compression sprayer operated at 20 to 25 pounds pressure.

The corn plants that received only an initial 5 p.p.m. nitrogen in the culture solution and those that received additional foliage applications of urea exhibited pronounced nitrogen deficiencies. A comparison of the dry weight indicated that there was no significant difference between the two treatments; however, when 100 p.p.m. of nitrogen were used in the culture solution the dry matter produced increased five fold.

Another experiment was conducted to compare the effect of the following fertilizer treatments on corn: (A) no nitrogen; (B) urea solution (5 g./l.) applied to the foliage; (C) urea solution (5 g./l.) applied to the rooting medium at the same rate as Treatment B; (D) 100 p.p.m. of nitrogen in the culture solution. An average of 74 ml. of urea solution containing 0.37 g. of urea was used for each of the six replications of treatments B and C. The foliar application of urea solution was made by delivering it from a 1 ml. pipette to the funnel formed by the leaf blades of the corn plant. The same volume of the solution was then added to the culture solution of another pot in the same replication. The applications were made several times a day over a period of 17 days.

There was no significant difference in the dry weight of the plants which received foliar applied nitrogen and those that received the same amount of nitrogen in the culture solution or rooting medium. Both were greater than the plants that received no nitrogen but less than those that initially received 100 p.p.m. nitrogen in the culture solution.

An experiment was carried out in the same manner as the preceding one to compare the growth and the per cent of nitrogen in the tissue of plants that received urea applied to foliage and rooting medium when an initial 5 p.p.m. nitrogen was used as a "starter" in the culture solution. The use of urea in addition to the 5 p.p.m. nitrogen used as a "starter" significantly increased yields. There was no significant difference in the dry weight of the plants when urea was applied to the foliage or culture solution. The per cent of nitrogen in the dry weight of roots and tops was slightly higher in the plants to which the solution had been applied to the foliage.

An experiment was carried out to determine the effect of foliar application of phosphorus on corn growth. Four replications of the following treatments were used: (A) no phosphorus; (B) monobasic potassium phosphate solution (10 g./l.) applied to foliage; (C) 30 p.p.m. phosphorus initially supplied in the culture solution.

The plants sprayed with the monobasic potassium phosphate solution were more vigorous, of better color, and produced significantly more dry matter than the plants receiving no phosphorus.

The effect on corn of foliar and root applied phosphorus was compared again by the following treatments: (A) no phosphorus; (B) monobasic potassium phosphate solution (8 g./l.) applied to foliage; (C) same concentration and volume of monobasic potassium phosphate used in treatment B added at the same time to the culture solution or rooting medium; and (D) 30 p.p.m. phosphorus initially supplied in the culture solution.

An average of 41 ml. of the solution containing approximately 0.33 gram of KH_2PO_4 was applied to each replication of treatments B and C. There was no significant difference in the dry matter produced by the plants foliar treated with KH_2PO_4 (treatment B) and those that received the same volume of KH_2PO_4 applied to the rooting medium (treatment C). Both produced significantly less dry matter than the plants that received an initial 30 p.p.m. phosphorus in the culture solution but significantly more than those that received no phosphorus.

The corn receiving treatments A, B, and C was analyzed to determine the per cent of phosphorus in the tissue. The phosphorus content of tops and roots of plants that were foliar treated with KH_2PO_4 was .096 and .072 per cent respectively, whereas, those plants treated with KH_2PO_4 through the culture solution contained .087 and .067 per cent respectively. Those plants grown in the absence of phosphorus contained .072 per cent P in the tops and .062 per cent P in the roots.

An experiment, similar to the gravel culture experiment described above was carried out to compare phosphorus application to the roots with phosphorus application to the foliage when the plants were grown in soil. The dry weight produced by the plants that received the solution applied to the foliage was 30 per cent greater than check, while the plants that received the same amount of solution applied to soil produced 40 per cent more dry matter than check. The relative increase in the phosphorus content of the tissue was 47 and 35 per cent respectively for foliar and soil applied potassium chloride solution.

An experiment utilizing radioactive phosphorus (P^{32}) solution (30.656 g. KH_2PO_4/l.) was carried out to compare the relative rates of absorption by plants and the movement in plants of phosphorus applied to the foliage and the rooting medium. The autoradiographs were prepared from disc samples taken from leaves at 24, 48, and 72 hours and also samples of leaf sections taken at 72 hours after the radioactive phosphorus was applied. The relative amount of phosphorus in the tissue of both the plants to which the material had been applied to the foliage or applied to the culture solution increased with time, but the amount for any given time was greater when the material was applied to the rooting medium.

An experiment to determine the effect on corn of foliar applied potassium was carried out with four replications of the following treatments: (A) no potassium; (B) potassium chloride solution (5 g./l.) applied to foliage; (C) an initial 100 p.p.m. potassium supplied in the culture solution.

The log and method of making the spray applications were the same as for the first experiment which was designed to determine the response of corn to foliar applied urea.

At the time treatment B was started potassium deficiency symptoms were very pronounced in both treatments A and B. However, after receiving six sparing applications, the dry weight of plants from treatment B was 25 per cent greater than the check, whereas the dry weight yield from treatment C was 64 per cent greater than the check.

Corn was planted to compare the growth of plants receiving the following treatments: (A) no potassium; (B) potassium chloride solution (5 g./l.) applied to the foliage; (C) the same volume of KCl solution applied at the same time to the culture solution or rooting medium; (D) an initial 100 p.p.m. of potassium in culture solution. An average of 62 ml. of the solution containing 0.31 g. of potassium chloride was applied to each of the six replications of treatments B and C.

Plants treated with potassium chloride solution through the rooting medium grew more rapidly at first than those that were foliar treated. However, after the foliar applications terminated, the foliar fertilized plants developed more rapidly. A statistical analysis of the dry weight indicated that there was no significant difference in the two treatments. Both produced less dry matter than the minus potassium treatment but less than the treatment that initially received 100 p.p.m. potassium in the culture solution.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

An experiment consisting of the following treatments was carried out to determine if foliar applied potassium would have an advantage over that applied to the rooting medium when corn is grown in soil: (A) no potash added; (B) KCl solution (5 g./l.) applied to foliage; (C) same volume of KCl solution used in Treatment B applied to soil.

An average of 60 ml. of potassium chloride solution was applied to each of the four replications of treatments B and C.

When observed several times during the course of the treatments and also at the termination, the three treatments showed no obvious difference in growth or appearance and eventually no significant difference in the dry matter produced.

The corn grown in soil failed to respond to foliar applications of potassium chloride probably because the soil supplied sufficient potassium for the plant. In an attempt to overcome this problem, the writer selected the soil of an alfalfa-trefoil experiment that received liberal applications of phosphorus but no potassium. An analysis showed that the exchangeable potassium content of this soil was 0.16 m.e. per 100 g. of soil. The experiment consisted of four replications of treatments which included one in which no potash was added to soil nor foliage and another in which the corn received four foliar applications of potassium chloride solution but no soil amendment. The other treatments consisted of additions of 50, 150 and 300 pounds per acre of 60 per cent muriate of potash with one series receiving four foliar applications while the other did not.

An analysis of the dry weight indicated that there was no significant difference in any of the treatments. There was a progressive increase in the potassium content of the tissue as the rate applied to the soil increased. At any given rate of soil application of potash, the potassium content of the sprayed plants was greater than those which did not receive this additional source of potassium.

An experiment, employing gravel culture, was carried out to compare the effect on corn of several forms of foliar applied nitrogen and phosphorus. The compounds used in the phosphorus and nitrogen treatments and the concentrations which supply equivalent amounts of phosphorus or nitrogen were as follows:

Phosphorus treatments: (A) no phosphorus; (B) 8 g. KH_2PO_4/l.; (C) 7.5 g. $Ca(H_2PO_4)_2\ H_2O$/l.; (D) 7.9 g. $(NH_4)_2HPO_4$/l.

Nitrogen treatments: (A) no nitrogen; (B) 3 g. NH_4NO_3/l.; (C) 4.7 g. $(NH_4)_2SO_4$/l.; (D) 4.7 g. $(NH_4)_2HPO_4$/l. All the nitrogen treatments received an initial 5 p.p.m. nitrogen in the culture solution.

A total of 65 ml. of the phosphorus solutions and 50 ml. of the nitrogen solutions was applied to each of the six replications of each treatment.

A statistical analysis of the dry weight indicated that there was no significant difference between the plants which had received a foliar application of different phosphorus carriers. The application of any one carrier resulted in more than a twofold increase in dry matter when compared with the untreated corn.

No significant increase in the dry weight resulted from the use of the nitrogen carriers.

Summary and Conclusions

A significant response of corn, in terms of growth, to the foliar application of urea was inconsistent when an initial 5 p.p.m. was supplied in the culture solution. The response was greater when no nitrogen was used as a starter but was still inferior to the plants that received an initial 100 p.p.m. nitrogen in the culture solution. There was no significant difference in the dry matter produced when equal volumes of urea solution were applied to foliage or rooting medium, but the nitrogen content of the tissue of the former was slightly higher.

The dry weight of corn did not increase significantly to the foliar application of ammonium nitrate, ammonium sulfate, or ammonium phosphate when 5 p.p.m. nitrogen was initially supplied in the culture solution.

A significant increase in dry matter and a slight increase in the phosphorus content of tissue resulted from the foliar application of phosphorus when grown in either gravel culture or soil. The increase in the dry weight of the corn that resulted from either the foliage or culture solution applied phosphorus was considerably less than the increase that resulted from an initial 30 p.p.m. phosphorus in the culture solution.

There was a significant increase in the dry weight of the corn which received foliar applied monobasic potassium phosphate, calcium phosphate, or ammonium phosphate when compared with plants that received no phosphorus. However, there was no significant difference in the response of corn to the three sources of phosphorus.

The comparison of the rate of absorption and movement of radioactive phosphorus by autoradiographs showed that for any given time the relative amount in the tissue was greater when the material was applied to the rooting medium than when applied to the foliage.

The foliar application of potassium chloride increased both the dry matter produced and potassium content of the corn tissue when the corn was grown in gravel culture. The corn responded only in terms of increased potassium content of tissue when grown in soil.

Microfilm $2.50; Xerox $3.80. 68 pages.

Abstract published by special arrangement with The Ohio State University.

PHYSIOLOGICAL AND CHEMICAL STUDIES ON THE KEEPING QUALITY OF BETTER TIMES ROSES

(L. C. Card No. Mic 59-5367)

Marvin Clinton Twigg, Ph.D.
The Ohio State University, 1952

Roses, though economically one of the most important of the cut flower crops, are one of the poorest of the cut flowers from the standpoint of keeping quality. Under average home conditions carnations or chrysanthemums may be expected to retain a presentable condition for a period up to seven days from the time they are sold by the retailer. Roses, under the same conditions, are usually ready for discard after the second or third day.

A number of factors are involved in the relatively poor keeping quality of cut roses. Among these are wilting or bending of the stem directly below the flower bud, wilting of petals, rapid opening of the buds, failure of the buds to open, and "bluing" of the petals of red rose

varieties. Any one of these factors may limit the longevity or otherwise reduce the quality of the flower.

The investigations reported in this paper are concerned with:

1. The effect of potassium and nitrogen nutrition of the rose plant on the keeping quality of cut roses
2. Chemical changes associated with bluing in petals of Better Times roses
3. Chemical changes associated with the retention of better petal color that results from the use of certain flower preservatives

The Effect of Soil Potassium and Nitrate Concentrations on the Keeping Quality of Better Times Roses.

In this study the keeping quality of Better Times roses grown at varying levels of nitrogen and potassium was observed. The results of these tests indicated that, except for high potassium levels, the potassium and nitrogen nutrition of the rose plant had no effect on the relative keeping quality of Better Times roses. It was observed that roses grown at high potassium levels showed a much greater tendency toward bluing than did those grown at low and intermediate levels of potassium. The soil potassium concentrations associated with the more extensive bluing were excessively high, above 60 parts per million. Concentrations of this intensity would not ordinarily be found under commercial conditions. However, it is possible that such high potassium concentrations could exist for short periods of time following heavy applications of potassium fertilizers. This could be an explanation of occasional reports by rose growers of periods during which bluing becomes a more serious problem. The nitrate level that existed together with the high potassium levels had no apparent effect on the bluing tendency of these roses.

The roses characterized by the excessive and rapid bluing were cut from plants having a leaf potassium content equal to 3.36 to 3.98 per cent of the dry weight. This greater tendency towards bluing was not apparent on roses cut from plants having a leaf potassium content up to 2.60 per cent of the dry weight.

Some Chemical Changes Associated With Bluing In Petals Of Better Times Roses.

In this study a series of chemical and physical tests were conducted in an effort to determine some of the factors associated with the bluing of Better Times roses and the possible cause of the more rapid bluing that resulted when the roses were grown at high potassium levels. In the course of the previous study it had been observed that the inner petals were the first to begin bluing.

It was found that though there was a quantitative difference in the anthocyanin content of inner and outer petals regardless of bluing, there was no correlation between anthocyanin concentration and bluing. The inner petals of bluing roses contained as high a concentration of pigment as the inner petals of non-bluing roses.

A comparison of the absorption spectra of anthocyanin and anthoxanthin extracts showed that the same pigments were present in fresh, blue, and non-bluing petals. It was found, however, that the anthoxanthin concentration was considerably greater in blue petals than in four day old non-blue petals. The anthoxanthin extracts were found to have an absorption peak at 355 mμ. The absorption peak of the anthocyanin extracts was at 515 mμ. Because of the close similarity of the absorption spectra of the anthocyanin extracts with a like extract from flowers of Centaurea cyanus, which are known to contain cyanin, the anthocyanin pigment contained in the Better Times rose is presumed to be cyanin, a 3,5 diglucoside of cyanidin.

The concentration of tannins or other phenolic compounds was found to be greater in the blue, inner petals than in the non-blue, outer petals of bluing roses. This difference was not noted between inner and outer petals of non-bluing roses. The analysis for phenolic compounds (tannins) in petals of freshly cut and four day old roses from the various differential nutrient plots did not show any relationship between the concentration of potassium and nitrate in the substrate and the concentration of tannins in the petals. The petals analyzed in these tests were the outer and mid petals and did not include the inner petals which showed the greatest tendency toward bluing. These results show that a deficiency of tannins, as reported by Currey[1] regarding the cause of bluing of roses of the variety Hadley, was not the cause of the bluing observed in Better Times roses.

The hydrogen ion concentration of the cell sap was found to decrease as the roses aged after being cut. The decrease was much greater in blue than in non-bluing flowers. The cell sap of bluing roses was generally found to have a pH value in excess of 5.35.

Mineral analyses of rose petals indicated a direct relationship between bluing and the potassium content of the petals. This may have been due to the formation of an additive complex between the potassium and the anthocyanin pigment. Bluing flowers were found to contain more potassium than non-bluing flowers. Likewise, bluing petals were found to contain more potassium than non-bluing petals from the same bloom. This relationship between bluing and potassium content of the petals existed regardless of the soil potassium level at which the rose might have been grown.

Some Chemical Changes in Petals Of Better Times Roses Resulting From The Use Of Flower Preservatives.

It has been shown that certain preparations are effective in maintaining a desirable color in red roses for an extended period of time. The present study was undertaken to determine some of the chemical changes occurring in the petals as a result of the use of several commercial flower preservatives.

The quantitative tests for anthocyanins indicated that the better petal color associated with the use of the flower preservatives was not due to a higher concentration of anthocyanins. The data showed that in most instances the use of these preservatives resulted in a slight decrease in anthocyanin content. Neither was there any correlation between the tannin content and petal color. The results of the pH measurements, showed that lower pH values were correlated with the use of the flower preservatives and better flower color.

Mineral analyses showed that as the roses aged after being cut the concentration of potassium, calculated on a dry weight basis, increased. This increase in potassium content was less in flowers that had been placed in the preservative solutions than in the check flowers that had been in water. Neither age nor preservative treatment had any apparent effect on petal calcium concentrations.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

A comparison of pigment extracts from petals of freshly cut, bluing, and preservative test flowers showed that there was no qualitative change in either the anthocyanin or anthoxanthin pigments. However, it may have been possible for a chemical, such as iron or aluminum, contained in the flower preservative to have formed an additive complex with the anthocyanin pigment in the petal which was later broken down when the pigment was extracted with a .1 N hydrochloric acid solvent. The fact that the color resulting from the use of the preservatives was "desirable" but not the normal color of Better Times roses is indicative of such a reaction. The concentration of the anthoxanthin pigment was found to be much lower in the pink petals of the preservative test flowers than in either fresh or blue petals.

Summary and Conclusions

From these studies the following summary and conclusions can be made:

1. The nitrogen status of the plant has no apparent effect on the keeping quality of cut Better Times roses.
2. Excessively high potassium concentrations in the substrate resulted in more rapid and more extensive bluing of Better Times roses. Bluing of rose petals was likewise correlated with a higher potassium content in the petals.
3. Qualitative or quantitative changes in the anthocyanin pigment were apparently not responsible for color changes in petals of Better Times roses.
4. Higher pH values, higher potassium content of petals, and higher concentrations of an anthoxanthin pigment were associated with bluing.
5. Phenolic compounds (tannins) were found to be higher in blue petals than in non-blue petals. The increase, however, seemed to be a result of and not the cause of the bluing.
6. The retention of the more desirable color found to be associated with the use of flower preservatives was accompanied by a reduction in pH values and in the concentration of an anthoxanthin pigment.
7. The fact that the color of petals associated with the use of flower preservatives was not the normal color of Better Times roses is indicative of an additive complex being formed in the petals with a material found in the preservative.
8. Better Times roses were found to contain an anthocyanin, having an absorption peak at 515 mμ in a .1 N hydrochloric acid extract and an anthoxanthin, having an absorption peak at 355 mμ in an ethyl acetate extract.

Microfilm $2.50; Xerox $5.00. 100 pages.

1. Currey, G. S. "The Cause of Bluing of Red Roses," Jour. Roy. Soc. New. So. Wales, 61 (1927), pp. 307-14.

Abstract published by special arrangement with The Ohio State University.

RELATIONSHIP BETWEEN OXYGEN DIFFUSION RATES, AS MEASURED WITH THE PLATINUM MICROELECTRODE, AND PLANT GROWTH.

(L. C. Card No. Mic 59-5958)

David Miller Van Doren, Jr., Ph.D.
Michigan State University, 1958

Major Professor: A. Earl Erickson

The purpose of this dissertation is to quantitatively evaluate the factors that influence the measurement of oxygen diffusion rates with the platinum microelectrode, and to evaluate the relationship between these rate measurements and plant growth.

Among the factors that influence the measurement are the length, degree of wetting, and physical and chemical history of the platinum wire, temperature, pH, and electrical resistance of the soil and interference from reducible substances other than oxygen. The limitations imposed on this measurement of oxygen diffusion rates by these factors is discussed.

Tomatoes, sugar beets and corn were used as indicator crops of the relationship between plant growth and oxygen diffusion rate measurement. An experiment performed in the greenhouse showed that short periods of oxygen stress may cause a considerable reduction in tomato vegetative growth, if such an oxygen stress occurs early in the tomato growth period. Tomato fruit was harvested prematurely and no such results are evident. In an experiment conducted in the field tomato plants were subjected to varying degrees of oxygen stress over most of the growing period. Those plants grown in plots in which the diffusion rates were below a certain "critical" rate in the early portion of the tomato growth period in general produced less vegetation and fruit than tomatoes grown in plots having diffusion rates greater than the "critical" rate for tomatoes.

Field oxygen diffusion rate measurements were made in sugar beet and corn plots at the Ferden farm in 1955, 1956, and 1957. These measurements show that sugar beets grown in plots in which the diffusion rates were below the "critical" rate for sugar beets over an extended period of time during the first half of the growth period did not yield as well as beets grown in plots having diffusion rates averaging in excess of this "critical" oxygen diffusion rate. Corn did not follow the same growth pattern with respect to oxygen diffusion rates as sugar beets.

The possibility of relating the rate of change of oxygen diffusion rates following rainfall or irrigation to eventual crop yield is presented. Existing data related to plant growth and "critical" oxygen diffusion rates are summarized. Microfilm $2.50; Xerox $4.20. 76 pages.

PARASITISM OF SEPTORIA OBESA SYD. AND S. CHRYSANTHEMELLA SACC. ON THE CULTIVATED CHRYSANTHEMUM

(L. C. Card No. Mic 59-6113)

Henry Thomas Waddell, Ph.D.
The University of Florida, 1959

Two species of Septoria were found in diseased chrysanthemum leaves collected in the United States. The valid names are Septoria obesa Syd. and Septoria chrysanthemella Sacc. The disease caused by Septoria obesa was of more frequent occurrence than the disease caused by Septoria chrysanthemella.

Pycnidia of Septoria obesa were globose to irregular in shape and were 60 to 160 microns in diameter. Pycnidia of Septoria chrysanthemella were pyriform or globose in shape and were 40 to 124 microns in diameter. Pycnidiospores of Septoria obesa were 44-108 x 2.6-4.5 microns, tapered from the base or mid-region to the apex, usually curved, and were distinctly 5 to 14 septate. Pycnidiospores of Septoria chrysanthemella were 22-70 x 1.8-3.0 microns, uniform in width, straight or slightly curved, and were obscurely 0 to 5 septate.

The pathogens were grown in pure culture under various controlled conditions. The optimum hydrogen-ion concentration for the growth of each fungus in a liquid medium at 20°C was pH 5 to pH 7. No growth occurred at pH 2 or pH 10. The optimum temperature for the growth of each pathogen on a solid medium was 20°C to 28°C. A small amount of growth occurred at 4°C, and there was no growth at 32°C.

Pycnidiospores of each fungus germinated at temperature of 8°C to 28°C. No germination occurred at 4°C or at 32°C. About 24 hours were required for pycnidiospores in water to begin germination.

The rates of growth of Septoria obesa and Septoria chrysanthemella were relatively rapid on a solid medium supplied with galactose, dextrose, mannose, sucrose, or maltose; growth was slower with D-mannitol and was very slow with lactose or in the absence of a carbon source.

Septoria obesa grew relatively rapidly on a solid medium when L-asparagine was used for a nitrogen source. The growth rate was moderate when L-arginine, ammonium sulfate, or potassium nitrate was used and was very slow with glycine, L-leucine, or with the lack of nitrogen. Septoria chrysanthemella grew rapidly when the nitrogen source was L-asparagine. The rate of growth was moderate with L-arginine, L-leucine, or potassium nitrate and was slow with glycine, ammonium sulfate or in the absence of a source of nitrogen. Septoria chrysanthemella did not sporulate when nitrogen was lacking or when ammonium sulfate was the nitrogen source.

Twenty-two chrysanthemum varieties of different ages were inoculated in the field and in the greenhouse with pycnidiospores of these pathogens. Septoria obesa severely attacked all host varieties, causing brown to black lesions of indefinite shape and size and frequently killing entire leaves. Septoria chrysanthemella infected all of the varieties causing black circular lesions usually less than 1 centimeter in diameter, but only the varieties Mary L. Hall and Bonnie were consistently severely attacked. The ages of the plants did not affect their susceptibility.

Infection and disease development were favored by moisture and by mild or cool temperatures. Pycnidiospores of the pathogens in diseased leaves left on the ground in December remained viable into March but not into April.

Host penetration was by hyphae of germinating pycnidiospores entering stomata in the abaxial surfaces of the leaf blades. A study of pathological anatomy revealed that mycelia of the pathogens invade tissues of the leaf blades intercellularly. No haustoria were found.

Microfilm $2.50; Xerox $4.80. 90 pages.

AGRICULTURE, PLANT PATHOLOGY

SELECTION IN BUNCH AND SINGLE PLANTED SUGARCANE SEEDLING NURSERIES AT LOUISIANA STATE UNIVERSITY

(L. C. Card No. Mic 59-5507)

Elton Ray Barrett, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Richard D. Breaux

A study was made at Louisiana Agricultural Experiment Station on selections and Brix of the selections in stubble stools of the C.P. 1955 series of crosses planted as single plants and bunches of 10; and on Brix (hand refractometer), sucrose (polarity), stalk diameter, stalk height, and stalk weight in clonal plots established from the selections. A slightly higher mean Brix was obtained for single stools than for bunches, however this difference may have been due to planting of larger numbers of some high sucrose crosses as single plant hills. Brix and sucrose of clonal plots from selections in single stools was also higher than in bunch stools, however some low sucrose canes in clonal plots established from single stools indicated that selection for Brix was not completely effective. The small mean differences indicate that the increase in the single stools is hardly worth the time and labor required for Brixing.

Bunches were slightly superior to singles in stalk diameter and stalk weight, but singles averaged slightly superior in height. These differences were not large enough to be of importance, thus one method of selection would be about as effective as the other for these characters.

Selection rates in clonal plots were about equal by the two methods of comparison used, which further indicated that selection in single stools for Brix was not highly effective. If Brix is not used in selection, a much larger number of seedlings can be handled with the same facilities, thus it was concluded that this method would be desirable at L.S.U. provided that a much larger number of clonal plots be grown from stubble selections. This would permit further testing of a larger number of seedlings in clonal plots.

Positive correlations were found between Brix of stubble seedlings and sucrose of increase plots in both bunches and singles with the latter giving the highest r

value. A high positive correlation was found between Brix (hand refractometer) and sucrose of 3 foot clonal plots of the selections from bunch planted hills. It was concluded that selection for Brix in 3 foot clonal plots would be effective for isolating high sucrose canes.

A study was also made of selections and Brix of the selections in stubble stools of the C.P. 1956 series of crosses planted as single plants and bunches of 10. There was very little difference in Brix of canes from the two methods of selection. The bunch selections showed an increase over the C.P. 1955 series in mean Brix. This was attributed to all crosses containing at least one high sucrose parent.

Survival studies of seedlings in the greenhouse indicated that a high percentage of the bunched seedlings are eliminated before becoming established in the field. It is felt that this early elimination is at random. Field studies also indicate that more than one cane per hill could be selected from plant cane seedlings without obtaining two canes of the same variety at a high frequency. However, selection of more than one per hill in stubble would greatly increase the possibilities of selecting two canes of the same variety. Microfilm $2.50; Xerox $4.60. 90 pages.

STUDIES ON PRATYLENCHUS ZEAE (NEMATODA, TYLENCHIDA) ON SUGARCANE IN LOUISIANA.

(L. C. Card No. Mic 59-5521)

Sekender Ali Khan, Ph.D.
Louisiana State University, 1959

Supervisor: Professor John P. Hollis

The distribution, morphology, parasitism and pathogenicity of a species of Pratylenchus was studied on sugarcane and other host plants in Louisiana cane fields in 1958 and 1959. Soil around roots and root samples was found uniformly infested with this species throughout the sugarcane growing area. Additional hosts, whose roots were parasitized by the nema in greenhouse tests, were sugarcane seedlings, corn, Sorghum halepense (L.) Pers., Digitaria sanguinalis L., Eleusine indica Gaertn., Echinochloa crusgalli (L.) Beauv. and Sporobolus poiretii (Roem and Schult.) Hitchc. Morphological studies indicated that the nema is a variant of Pratylenchus zeae Graham 1951.

Pure populations of the nema reproduced readily on sugarcane grown in steam sterilized soil in the greenhouse. Growth and development of sugarcane was severely retarded by populations of the nema alone and in combination with a fungus, Phytophthora megasperma Drechsl. Symptoms of the disease were chlorosis, stiffening and shortening of leaf blades and internodal sheaths and a decrease in number of internodes. Root damage was characterized by partial destruction of the feeder root systems and by the presence of dark-red lesions, round, oval or elongated in shape. P. zeae and P. megasperma in combination were found to exert their effects on sugarcane independently of each other. Both organisms, alone or in combination, caused significant reductions in green and dry weights of stalks and leaves from plant cane (initial cutting from greenhouse pots). In stubble cane (regenerated growth following the initial harvest of tops in greenhouse pots), similar but nonsignificant effects of the nema were recorded. Populations of Pratylenchus zeae in sugarcane roots were higher when Phytophthora megasperma was also present.

Tests with the nema for transmission of ratoon stunt virus in sugarcane were negative.

Microfilm $2.50; Xerox $3.00. 56 pages.

STUDIES ON RESISTANCE IN RADISH TO FUSARIUM OXYSPORUM f. CONGLUTINANS RACE 2.

(L. C. Card No. Mic 59-5813)

Joseph Louis Peterson, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Glenn S. Pound

This investigation had 2 main purposes. The first dealt with the nature of resistance in Early Scarlet Globe radish to the yellows organism, Fusarium oxysporum f. conglutinans race 2, and included studies on the relation of plant age, inoculum dosage, and method of inoculation to resistance. The second was to study the inheritance of resistance in radish to Fusarium yellows. Attempts were made to introduce the resistance of the Early Scarlet Globe radish into the White Icicle radish variety.

Penetration by the fungus in susceptible and resistant varieties was both direct and indirect. Penetration was observed to occur through the root tips of both primary and secondary roots and through epidermal and cortical tissues of the region of differentiation. Penetration in higher areas of the root occurred rarely and was not observed at all in the hypocotyl. Root hair penetration also occurred but was considered to be of minor importance.

Invasion through the cortical region was both intercellular and intracellular. Advance by the fungus was principally in the direction of the stele and the fungus was not found to traverse up the cortex to any extent. There was very little difference in the extent of fungal invasion between the varieties in this region.

Vascular invasion of the 2 varieties was noted, but the amount of mycelium observed in the vessels of the resistant variety was meager. Deterioration of the vascular area occurred, particularly in the cambial region, when the root was infected. The fungus was found to ultimately invade the cortex from the vascular area causing a cortical deterioration. Conidial and chlamydospore formation in the xylem vessels was observed in only the susceptible line.

Normal suberized thickenings of cortical cells and the endodermis were not effective barriers to the fungus and there were no suberized thickenings formed in response to fungal penetration. Epidermal and sub-epidermal cells often became plasmolyzed and granulation sometimes occurred in response to the entrance of the fungus in both varieties.

The fungus was shown to traverse to the upper parts of susceptible plants including the leaves and the apical meristem. Plants which were infected in apical meristem

areas usually failed to form buds. The resistant varieties rarely showed penetration above the lower hypocotyl region. It is believed that resistance is localized principally in the vascular system and is not due to any morphological barrier inhibiting growth of the fungus.

In plants inoculated at various age levels there was no appreciable difference in age of plants in relation to resistance. Plants infected when older tended to survive longer than younger infected plants.

Concentration of inoculum was observed to have an effect on disease development, producing the most severe reaction with the greatest concentration of inoculum. Stroking of roots to injure them before dipping in the fungal suspension produced a more severe disease reaction in the heavier concentration treatments.

Selfed progenies of the resistant line appeared to be nearly 100 percent resistant. The F_1 progenies of crosses between susceptible and resistant plants showed considerable variation in resistance and were intermediate between the susceptible and resistant parents. The F_2 progenies and backcross progenies showed resistance of about 15 percent. These findings indicate that resistance to Fusarium yellows is polygenic in nature.

Resistance was introduced in the White Icicle line. F_2 plants from sibbed F_1 plants were grown in the field and selection was made for the long White Icicle type from this generation. From these selected F_2 plants, F_3 progenies were obtained and tested for resistance. Resistance is now being built up in the White Icicle line.

Microfilm $2.50; Xerox $6.40. 131 pages.

STUDIES ON DEVELOPMENT AND SPREAD OF RED ROT IN A SUGARCANE PLANT

(L. C. Card No. Mic 59-5528)

Giri Raj Singh, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Irvin L. Forbes

The present studies were made in order to obtain more information on the development and spread of the red rot fungus in a sugarcane plant. Isolations from the young field-grown shoots were made during the spring. Cultures of the red rot fungus were obtained from leaf scars, leaf sheaths, and internal tissues of these shoots. The average recovery of red rot from leaf scars, leaf sheaths and internal tissues of both plant and stubble shoots, from 1957 to 1959, was 23.1, 28.0 and 1.4 per cent respectively. The buds and bud scales of underground portions of shoots were found to be infected up to 22.3 and 26.3 per cent respectively. Leaf scars and internal tissues of the underground stubble pieces of August planted cane, whose shoots were killed during the winter, also gave red rot.

The shoots grown in the greenhouse from field-inoculated seed cane became infected. Cultures made from leaf scars, leaf sheaths, growing points and internal rolled leaves gave 17.9, 5.0, 3.9 and 1.0 per cent red rot respectively, whereas from shoots of non-inoculated seed cane, the leaf scars, leaf sheaths, growing points and internal rolled leaves gave 4.3, 5.8, 1.5 and 0.2 per cent red rot respectively.

The fungus was cultured from uninjured midribs, inoculated in moist chambers. The recovery after one day was 35.7, after two days 73.8, after three days 79.1, and after four and five days 92.8 per cent. Red rot was reisolated from these midribs after sterilization in a solution of 1:1000 mercuric chloride in 50 per cent alcohol up to 2 hours, which demonstrated the effect of surface sterilization upon the infection of the red rot fungus.

Infection threads from germinating spores on the upper surface of leaves were sometimes observed to penetrate the waxy cuticle. Uninjured, inoculated midribs of greenhouse plants developed pin-point size lesions on some blades. Isolations from these, one month later, gave 60.8 and 68.8 per cent red rot in the varieties Co. 290 and C.P. 44-101. A difference in the percentage of red rot recovery was obtained from inoculation of upper and lower surfaces, being 58.6 and 71.1 per cent respectively.

From leaf sheath inoculations in the greenhouse, first symptoms were observed within 24 hours on leaf sheaths, and lesions developed within six or more days on the blades. When leaf sheaths were inoculated with injury, symptoms appeared on sheaths within 24 hours and lesions on blades after 48 hours. Re-isolations from sheath and blade gave the fungus. Isolations from between lesions did not give the fungus in all cases. Microscopic examinations of hand-made sections from the above leaves, showed atypical spore production inside the vessels and parenchyma cells. In older lesions, mycelium produced more typical spores.

When leaves, with and without sheaths, were placed in a spore suspension for 4 hours, dispersed midrib lesions were developed within 36-48 hours, as a result of spore migration through the ligular region of the leaf.

Leaf sheaths from the field, showing inside reddening, when placed in moist chambers, developed red rot conidia. Reddened midrib lesions, in the early season, did not give the red rot fungus. However, from apparently healthy leaves from the field in late season, the fungus was often recovered. Isolations from between lesions did not always give the red rot fungus.

Microfilm $2.50; Xerox $5.60. 112 pages.

STUDIES ON THE PHYSIOLOGY OF PARASITISM AS RELATED TO SCAB OF CUCUMBER INCITED BY *CLADOSPORIUM CUCUMERINUM*

(L. C. Card No. Mic 59-6564)

David Lewis Strider, Ph.D.
North Carolina State College, 1959

Supervisor: Nash Nicks Winstead

Highly resistant cucumber tissue became susceptible to *C. cucumerinum* under conditions of extended periods of high humidity during incubation. *In vitro* studies showed that temperatures of 30° C and above were lethal to the pathogen and that the optimum pH for growth on a citric acid-buffered medium was between 3.5 and 4.0. When citric acid was replaced with 10^{-2} M acetic, propionic, or butyric acids, the pathogen was killed at or below this pH optimum. The pH dependence of this toxic effect was

shown when a medium containing 1.5 percent acetic acid rendered the fungus inviable at pH 6.1 but not at 6.2. Growth was stimulated above 6.2. Acetic acid inhibition of growth was demonstrated with several other fungi. Although the growth of Aspergillus flavus was prevented with acetic acid-buffered media at low pH values, spores were not killed and resumed growth when transferred to PDA.

The fungus utilized many different carbon and nitrogen sources. Growth was observed on each of 22 amino acids tested as nitrogen sources except cysteine. Cysteine was toxic at a concentration of between 10^{-3} and 10^{-4} M in the presence of KNO_3. Better growth occurred on asparagine alone as a nitrogen source than on the asparagine-KNO_3 combination. Best growth occurred on aspartic acid treatments.

Analysis of extracts of cucumber fruit harvested in the fall revealed striking differences in aspartic acid concentration of the resistant and susceptible varieties, Fletcher and Stono. Fruits harvested in the spring failed to show this correlation. Extended dark periods prior to inoculation increased the susceptibility of the resistant variety. Attempts made to alter the susceptibility of resistant tissue by aspartic acid amendments proved successful. Large necrotic lesions developed on aspartic acid-treated resistant leaves of Fletcher seedlings after inoculation. Only occasional lesions developed when asparagine, glycine, or dextrose were used as amendments.

C. cucumerinum was found to produce cellulase, PG, and PME in vitro. Cellulase activity was demonstrated from cultures containing cellulosic as well as non-cellulosic carbon sources. The greatest production of PG occurred in cultures containing citrus pectin as a carbon source. PME activity was demonstrated in cultures containing citrus pectin or sodium polypectate as carbon sources.

The commercial cellulase preparation used was found to be extremely heat-stable as was the cellulase produced by a Penicillium sp. The cellulase produced by C. cucumerinum was heat-labile. Slight activity on CMC was recorded after the commercial cellulase had been autoclaved at 123° C for 60 minutes.

In vivo studies revealed large amounts of cellulase in scab-diseased cucumber seedlings. Very little PG was found. Production of PME by the fungus in cucumber tissue was not determined since the healthy suscept contained large amounts of this enzyme.

Certain filtrates of C. cucumerinum were shown to disintegrate cucumber tissue. Commercial cellulase and PG enzymes as well as a cellulase-active Penicillium filtrate failed to disintegrate cucumber tissue.

The marked differences observed in the heat sensitivity of the cellulolytic enzymes from different sources were interpreted as support of the multienzymatic cellulase theory of Reese (1956). The important possibility of the continued disintegration of cellulosic material by cellulase after the cellulase-producing organism had been destroyed was discussed. Since only small amounts of PG but large amounts of cellulase were found in diseased cucumber sap, it was suggested that the cellulase produced by C. cucumerinum is the pathogen's primary means of disintegrating cucumber tissue. The ability of the Cladosporium filtrate to disintegrate cucumber tissue and the lack of this ability of the cellulase from other sources, suggested the presence of more than one cellulase-type enzyme or the presence in C. cucumerinum filtrates of a heat-labile toxin other than cellulase.

Microfilm $2.50; Xerox $5.20. 101 pages.

STUDIES ON PHYTOPHTHORA SEED PIECE ROT OF SUGARCANE AND THE PRINCIPAL CAUSAL ORGANISM P. MEGASPERMA DRECHS.

(L. C. Card No. Mic 59-5530)

Tom van der Zwet, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Irvin L. Forbes

A study was made of the Phytophthora seed piece rot of sugarcane in Louisiana. The principal causal organism of this disease has been known for many years as a "sterile" Phytophthora isolate, due to the absence of fruiting structures, while a lesser pathogenic isolate had been identified as P. erythroseptica Pethyb.

In the present study, it was found that the "sterile" isolate will produce fruiting structures, when the fungus is grown on sterilized oat grains. After these grains were placed in tap water, many sporangia and chlamydospores were also observed. A complete description of this isolate has been given.

After comparative studies with several type cultures of seemingly related species of Phytophthora, in respect to morphology, growth-temperature relations and pathogenicity, the principal causal organism of sugarcane seed piece rot has been identified as P. megasperma Drechsler. The isolate was found to have an optimum growth temperature of 20°-22° C., with a range from 6°-32° C.

In basic infection studies, it was found that the initial infection of the seed pieces takes place at the root primordia and buds of each node. After having been planted 9 weeks in sterilized, artificially infested soil, the variety C.P. 36-13 showed 67.9 per cent of the root primordia and 80.0 per cent of the buds infected, this being somewhat less for the variety N.Co. 310. Since it was also noticed, that none of the still healthy root primordia and buds of the seed pieces planted in infested soil had germinated, it is suggested that the fungus may be producing a toxin, which inhibits the germination process.

In order to study the rate of spread of Phytophthora inside the cane, the internodes of 2-eyed seed pieces of the varieties C.P. 36-13 and N.Co. 310 were inoculated with the isolate. It was observed that the fungus reached the nodal regions 20 days after inoculation, while after 50 days the internode had almost entirely deteriorated.

In a comparative susceptibility experiment, in which the varieties P.O.J. 213, Co. 290 and C.P. 36-13 were tested in regard to red rot and Phytophthora rot, it was found that C.P. 36-13 was most susceptible to Phytophthora rot, while the other two varieties were about equal in their reaction to the disease.

An extensive varietal field test was carried out during the winter and spring seasons of 1957-1958 and 1958-1959, in which many past and present commercial sugarcane varieties and some unreleased test field varieties

were studied in regard to their susceptibility to Phytophthora seed piece rot. From the data collected during this two year testing program, it is concluded that the varieties C.P. 28-19, C.P. 34-120, C.P. 36-13, C.P. 44-154, C.P. 53-1, C.P. 53-15, C.P. 53-22 and C.P. 55-30 are susceptible to the seed piece rot, while the following varieties are considered resistant: Co. 281, N.Co. 310, C.P. 29-116, C.P. 43-47, C.P. 44-101, C.P. 47-193, C.P. 48-103 and C.P. 51-21.

A survey made in the sugar belt during the spring of 1958, revealed the fact that higher percentages of Phytophthora cultures were obtained from seed pieces planted from late September until November than from those planted earlier. Microfilm $2.50; Xerox $6.20. 129 pages.

ANATOMY

NEUROCYTOLOGICAL STUDIES OF EXPERIMENTAL ASCENDING TETANUS IN THE ALBINO RAT

(L. C. Card No. Mic 59-6605)

Jean Annarilla Foster, Ph.D.
University of Kansas, 1959

Previous experimental investigations have failed to provide decisive evidence concerning the cellular pathology of tetanus intoxication. The present studies were undertaken to correlate symptomatic stages of ascending tetanus with neuronal alterations at the lumbar, thoracic and cervical levels of the spinal cord. Histochemical procedures and fluorescence microscopy of acridine orange (pH 4.6) stained sections were utilized in order to supplement the data obtained from cell counts of gallocyanin stained sections. The experimental studies included intact, cord-transected and immobilized animals.

Intact animals injected intramuscularly with tetanus toxin demonstrated the typical syndrome of ascending tetanus. The symptoms appearing successively were local tetanus, scoliosus, emprosthotonus, thoracic bump and the cephalic syndrome. When animals were injected with 5 MLD of toxin intramuscularly increased numbers of anterior horn cells showed variations from the normal Nissl pattern in the three levels of the spinal cord at 33, 48 and 56 hours. This finding indicated a correlation between the symptoms of the ascending syndrome and the extent of alteration of the anterior horn cells of the cord. In contrast, intravenously injected animals show symptoms referable to the spinal cord terminally only. The axial musculature of these animals was affected only 5 to 10 hours prior to death and after the onset of general tetanus. No cytological changes were found in the anterior horn cells. Apparently, insufficient time had elapsed during the spinal cord symptomatic period for the appearance of such changes. The cytological evidence of neuronal alterations in intramuscularly injected animals but not in intravenously injected animals supports the conclusion that tetanus toxin (or a biochemical lesion caused by its action) spreads upward along the cerebrospinal axis in ascending tetanus. Cord transection almost doubled the survival period of intramuscularly injected animals. However, since immobilization in plaster casts also slightly extended the survival period, it could not be stated unequivocally that the prolongation was due to a block at the site of transection.

The cytological picture in relatively acute animals differed from that in animals injected with lower dosages of toxin. In acute animals (5 MLD of toxin intramuscularly) the typical chromophilic cells (gallocyanin stain) were not severely changed. Variations from the normal cytology were more easily observed with acridine orange staining. The nucleolus and nucleolus-associated chromatin of the anterior horn cells exhibited bright orange staining as compared to the yellow-green appearance of these same structures in normal cells. This suggested a heightened effusion of RNA and intensified metabolic activity in the anterior horn cells of animals injected with relatively large dosages of tetanus toxin. In contrast, the predominant anterior horn cell change was chromophobia in animals injected with smaller dosages and surviving for longer periods of time. Presumably, protracted irritation resulted in severe depletion of nucleoproteins.

Intact animals inoculated intramuscularly with 5 MLD of toxin showed altered fluorescence (with acridine orange at pH 4.6) of small interneurones at 22 hours, the time of appearance of local tetanus. In animals surviving longer periods, many of these small cells contained extremely pyknotic nuclei. Compared to the anterior horn cells, the small interneurones of the intermediate and central gray seemed to be more severely affected in these animals (1 MLD dosages). The fact that these cells show alterations early and that relatively higher numbers of them are irreversibly injured adds to the belief that, in tetanus intoxication, the primary injury is to the small interneurones. The changes observed in the anterior horn cells are probably secondary and result from the loss of inhibition.

The enhanced effusion of RNA in anterior horn cells following injection of 5 MLD of toxin constitutes cytological evidence for this unbalanced facilitation of the cells. Furthermore, in animals surviving 149 hours (1 MLD dosages), severe depletion of nucleoproteins of all anterior horn cells was observed. This depletion was associated with the occurrence of spontaneous convulsions over long periods of time. Microfilm $2.50; Xerox $5.00. 97 pages.

HISTODIFFERENTIATION OF ORAL EPITHELIUM IN THE ADULT MOUSE

(L. C. Card No. Mic 59-6826)

Herman Medak, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

The purpose of this study was to provide a general working knowledge of the oral mucosa in the mouse and to compare two different types of keratinization which occur in this tissue.

Four small areas were investigated: a thicker area in the lateral portion of the palate and a thinner area in the center of the palate, both of which had a compact type of keratin, and further a thicker area in the cheek and a thinner area in the floor of the mouth, both of which had a loose type of keratin.

Thickness of the cellular portion, proportional thickness of keratin, and mitotic frequency and location, were determined and estimates made of turnover times, daily rates of proliferation and cell size.

Special keratin and special connective tissue stains and histochemical methods for ribo- and desoxyribonucleic acids, glycogen and mucopolysaccharides, sulfhydril- and disulfide groups and the hydrolytic phosphatases were used. The main findings and conclusions are summarized below.

The proportion of keratin to thickness of the cellular layer was about 20% in the floor of the mouth, 38% in the center of the palate, 45% in the lateral portion of the palate and 48% in the cheek.

It was concluded that a thicker cellular layer is required for the maintenance of a thicker layer of keratin. However, a proportionally small increase in cellular width results in a proportionally larger increase in the width of the keratin.

The times for complete renewal of the epithelial cells were found to be about 17 days for the cheek, 21 days for the floor of the mouth, 24 days for the lateral area and 25 days for the central area of the palate.

The daily rates of regrowth were computed to be about 1 μ for the floor of the mouth, 2 μ for the center, 3 μ for the lateral area of the palate and 7 μ for the cheek.

It was concluded that maintenance of a thickly keratinized epithelium is less economical than maintenance of a thinly keratinized epithelium. Maintenance of a thick layer of loose keratin is least economical, but may be necessary where for functional reasons flexibility and thickness of keratin have to be combined.

The epithelium of the oral mucosa was found to resemble epidermal epithelium with respect to the progressive disintegration of the nucleic acids, to the absence of glycogen, alkaline phosphatase and cellular sudan-positive lipids, further with respect to the localization of phosphamidase.

Areas producing compact keratin were found to differ from areas producing loose keratin in the type of underlying connective tissue; the morphology of the basement membrane; the prominence of the tonofibrils, cell membranes and intercellular bridges; the location, size, inclusiveness and staining properties of the keratohyaline granules; and the consistency and staining properties of the keratin layer.

It was concluded that loose keratin is chemically unstable and that its surface layer is altered by the action of saliva, whereas compact keratin is resistant to saliva.

It is suggested that the instability of loose keratin is caused by (a) the lower proportion of tonofibril precursors in the keratin, (b) the incomplete conversion of keratohyaline to keratin due to the small surface available for exchange reactions, and (c) the failure to include all cytoplasm into the keratohyaline granules, which results in a non-keratinous component of the keratin layer.

Microfilm $2.50; Xerox $7.80. 162 pages.

A COMPREHENSIVE INVESTIGATION ON THE MORPHOLOGY OF RAUWOLFIA VOMITORIA AFZL.

(L. C. Card No. Mic 59-6570)

Abdul Jabbar Mia, Ph.D.
North Carolina State College, 1959

Supervisor: Ernest Ball

A comprehensive morpho-histological study of the embryo, seedling and adult plant of Rauwolfia vomitoria has been made. The shoot apex of the embryo is flat, while in the seedling it is elevated above the youngest leaf primordia. In the adult plant the shoot apex varies from a flat to a concave shape. The shoot apex of the embryo is composed of two layers of tunica and a mass of corpus, while in the seedling and adult plant the apical meristem is composed of three to five layers of tunica, a mass of corpus and three to five layers of cambium-like cells. The shoot apex is without flank meristem and the pith is derived from the cambium-like cells.

The anatomy of the stem and the root has been described. The young stem and root possess a uniseriate epidermis, multi-layered cortex and a stele, but in the older root the epidermis and the cortex are sloughed off subsequent to the development of periderm. The stem possesses both external and internal phloem, but the root does not have internal phloem. The phloem consists of phloem parenchyma and sieve tubes with simple, slightly oblique to transverse sieve plates. Each sieve tube element is associated with a single, long, narrow companion cell. The wood is composed of vessels, tracheids, fiber tracheids, libriform fibers and wood parenchyma which occur in variable proportions in the stem and root. The vessel elements possess bordered pits alternately arranged, a simple perforation on very oblique plates and a long tapering terminal extension at one or both ends.

The vascular cambium is composed of fusiform and ray initials. The fusiform initials are irregularly arranged with overlapping tapering ends.

The leaf is dorsiventral with uniseriate epidermis, multi-layered ground parenchyma in the midrib, one layer of palisade and several layers of spongy parenchyma. The leaf trace is bicollateral and v- or crescent-shaped. The reticulate venation has minor veins ending freely in the mesophyll; each ending is with one or two helical tracheids.

The root tip is comprised of three tiers of initials.

The sclereids, in the nodal regions of the stem, originate from the ground parenchyma, but in the root they

differentiate from phelloderm. The sclereids are polymorphic in nature and occur in vertical rows one above the other.

An articulated anatomosing type of laticifer occurs in the shoot tip, young leaf and in the stem pith but is absent from the root.

A systematic topographical study of parenchymatous cells has been made with reference to the primary tissues. Twenty different forms have been described.

Microfilm $2.65; Xerox $9.20. 202 pages.

HISTOCHEMISTRY OF BONE MATRIX DURING REST AND RESORPTION

(L. C. Card No. Mic 59-6829)

James Amos Yaeger, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

Histochemical studies can provide information concerning the interactions occurring in bone matrix among the mineral, collagen and polysaccharide-protein complexes, and the changes in these interactions or changes in the individual components during resorption. Studies previously reported contain conflicting descriptions of the histochemical reactions of calcified bone, and the data concerning bone matrix during resorption and after treatment with enzymes and demineralized agents are incomplete. The object of this study was to explain the conflicting data and supplement the studies of bone during resorption and after treatment with demineralizing agents and collagenase.

Five week old rats were injected with parathyroid hormone to induce bone resorption. The femora of these animals, as well as femora of untreated controls, were split and frozen-dehydrated. A method was developed for embedding and sectioning bones in methacrylate. Serial sections, fixed overnight in absolute alcohol, were stained with hematoxylin and eosin, alizarin red S, silver nitrate, toluidin blue O, periodic acid-Schiff solutions or picrofuchsin. Both buffered and unbuffered alizarin solutions were used at several concentrations and staining times. Silver nitrate was used at several concentrations and staining times, followed by exposure to light for various periods. The Hotchkiss alcoholic periodic acid-Schiff procedure was used both with and without reducing rinses and with several oxidation times and staining times in Schiff's solution. Toluidin blue was used at several concentrations and staining times, at pH 7.2 and 4.5 and both with and without alcohol dehydration. Weigert's picrofuchsin was used full strength and in various dilutions with saturated picric acid and for several staining times.

Femora of untreated animals, embedded, sectioned and fixed as above, were demineralized in nitric acid or ethylene diamine tetra-acetate. Other sections were treated with collagenase. These reagent-treated sections were stained with 0.03% toluidin blue at pH 7.2 and 4.5 and examined wet and after alcohol dehydration, by the Hotchkiss periodic acid-Schiff procedure without reducing rinses, with unbuffered 0.1% alizarin red S, 1/8% silver nitrate and Weigert's picrofuchsin.

Calcified bone matrix was found to be weakly periodic acid-Schiff positive when reducing rinses were used and more strongly positive without reducing rinses. The intensity of the staining increased as oxidation time in periodic acid increased over the range of 3 to 30 minutes. A red-purple color could be induced in mature bone only with relatively concentrated solutions (0.1%-0.5%). This color did not occur at pH 4.5, and was lost after alcohol dehydration. Mature matrix stained strongly with picrofuchsin, alizarin and silver nitrate.

Matrix beneath osteoclasts (identified in alternate sections stained with hematoxylin and eosin) was more strongly periodic acid-Schiff reactive than resting matrix, but stained the same as resting matrix with toluidin blue, silver nitrate, alizarin and picrofuchsin. Osteoclasts contained granules which stained with alizarin, periodic acid-Schiff solutions and metachromatically with toluidin blue, but not with silver nitrate.

In sections demineralized in acid, bone matrix was red-purple with the more dilute toluidin blue solutions (0.03%), but the color did not occur at pH 4.5 and was lost in alcohol. Bone matrix in sections demineralized in chelating solutions stained the same with toluidin blue as untreated matrix. After either method of demineralization the matrix was more periodic acid-Schiff reactive than untreated sections. Collagenase was only effective in unfixed, demineralized sections. After treatment with collagenase, periodic acid-Schiff reactivity was lost at about the same rate as picrofuchsin staining. No metachromasia was detected in collagenase-treated sections.

These data are interpreted as indicating that bone mineral, perhaps extra-crystalline calcium, interacts with the polysaccharides at sites other than their sulphate groups. One of the initial changes in bone matrix during resorption may be the removal of this extra-crystalline calcium by osteoclasts, leaving the crystalline mineral relatively intact.

Microfilm $2.50; Xerox $5.20. 104 pages.

A SURVEY OF VANDALISM AND ITS CULTURAL ANTECEDENTS ON FOUR NEW YORK STATE INDIAN RESERVATIONS

(L. C. Card No. Mic 59-6303)

Carol Ann Fisher, D.S.S.
Syracuse University, 1959

Supervisors: Douglas G. Haring
Nathan Goldman

The purpose of the present study was to undertake a general survey of the problems of vandalism encountered on four New York State Indian reservations. The research was undertaken to ascertain whether a general descriptive survey of the problem among peoples of other than Euro-American cultural heritage might illuminate or direct the formulation of hypotheses on the problem in our own culture. The survey was designed to discover what aspects, if any, of vandalism seem to be duplicated across specific cultural lines and whether differences might be related to differences in historical and cultural backgrounds.

This research was made possible through a grant from the Syracuse University Vandalism Study Project under the direction of Dr. Nathan Goldman. The summer and fall of 1957 were utilized for field study on the following reservations: Cattaraugus, St. Regis, Tonawanda, and Onondaga.

The method was that of informal interviews. Procedure was to develop a general picture of past and present conditions through reading prior to actual visits. Dr. William Fenton of the New York State Historical Museum was consulted for names of individuals who might provide useful initial contacts on the reservations. A cross section of school personnel and reservation residents were interviewed as well as civil authorities and farmers, shopkeepers, etc., in neighboring areas.

The researcher endeavored to obtain information on the following topics: occurrences of vandalism, functions and status of public or communal buildings, background of children known to be involved in vandalism, attitudes of residents toward public or communal buildings, general reservation morale and organization, socio-economic status, attitudes toward property, and attitudes toward discipline of young people.

The survey data is presented together with a general account of the history and seventeenth century culture of the Iroquois.

The data seem to offer evidence that there are two distinct patterns of vandalism among the Indians studied. The first is a pattern of behavior based on Indian tradition and condoned by adult Indians. The second pattern of vandalism is in imitation of "white" vandalism and delinquency and does not meet with adult Indian approval.

Acts of destruction that represent an expression of personal or community antagonism cannot be called by a term that would imply behavior in violation of the law or community norms on the reservations, i.e., vandalism or delinquency, since these acts are within Indian tradition. Random acts of destruction, the formation of "gangs", petty stealing and joy riding are not within Indian tradition and not only are condemned by the Indian community but are universally blamed upon learnings from "white" tradition.

These materials from the four Indian reservations do not provide specific hypotheses or generalizations on causal factors in vandalism. However, they suggest approaches and problem areas for further research. The principal areas of interest provided from the organization of these materials are as follows:

1. The general availability of parental surrogates on the Indian reservations as this might operate to reduce the percentage of juvenile problems.
2. Acts of destruction that appear to represent expressions of personal and community antagonisms.
3. The fear of community and personal shame as a deterrent to acts of destruction.
4. The influence of strong personalities at the head of public facilities and their interaction with the community.
5. Differentials in Indian and white children's concepts of ownership.
6. Rural and urban differentials in vandalism and the influence of television.
7. The emergence of two distinct patterns of destructive behavior.

Microfilm $2.50; Xerox $7.80. 169 pages.

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SOME ASPECTS OF THE IMMUNOCHEMISTRY OF COXIELLA BURNETII

(L. C. Card No. Mic 59-6601)

Yvonne Dolores Bobb, Ph.D.
University of Kansas, 1959

The present studies were undertaken to elucidate some of the chemical and immunological characteristics of Coxiella burnetii, an organism which differs in several important respects from other rickettsiae. These studies proceeded along three general lines of investigation. First, the effect of various physical and chemical agents on C. burnetii was studied to obtain information concerning the chemical nature and possible means of isolation of the complement-fixing (CF) or other soluble antigens. Second, quantitative methods for the titration of the rickettsiae in embryonated eggs and for the standardization of antigen preparations were investigated. Finally, a comparison was made between the Phase 1 guinea pig strain and the Phase 2 egg-adapted strain in an effort to learn how rickettsiae in the two phases differ with respect to their chemical and biological characteristics.

Studies of the CF antigen of C. burnetii revealed that the antigen is very stable to heat, resists digestion by lipase, lecithinase, DNase, RNase and lysozyme and is not inactivated by periodate oxidation. The destruction of serological activity was noted after extraction with Duponol and sodium desoxycholate and partial inactivation occurred after trypsin digestion. Treatment for 1 hour in the sonic oscillator or 2 minutes in the Nossal shaker or extraction with n-butanol had no effect on the CF activity. The in vitro serological activity was not reduced by treatment with 0.2N HCl at 80 C for 15 minutes or 37 C for 60 minutes but was significantly reduced when held at 100 C for 15 minutes. When 0.2N NaOH was employed, there was no effect after 60 minutes at 37 C, a partial reduction in titer after 15 minutes at 56 C and complete inactivation after 15 minutes at 100 C.

No apparent release of a soluble CF or skin-test antigen to the supernatant fluid was effected by treatment with n-butanol, Duponol, sodium desoxycholate, Nossal shaking or sonic disintegration. Rickettsiae treated as described did not lose their ability to act as skin test antigens. Organisms subjected to the physical and chemical treatments described in this and the preceding paragraph were examined in the electron microscope and compared with "untreated" rickettsiae. The effect of treatment upon the cell walls and protoplasts is described and micrographs of representative cells are included.

Indirect evidence pointing to the protein nature of the CF antigen and its probable location in the protoplast rather than in the cell wall is discussed. The concentration and purification of the organisms by means of aggregation and washing could be accomplished by the use of 0.2N HCl or the alkaline-calcium reagent.

Probit analysis was used for the estimation of the LD_{50} and the DD_{50} (average day of death). Plots of data by the described methods are of value not only in determining whether or not the data follow a normal pattern but also in assessing the validity of the data. For the determination of the Egg LD_{50}, the superiority of the formulated "dose-time curve" over the Reed-Muench and Karber end-point methods has been stressed.

It has been established that Phase 1 or Phase 2 antigens, adjusted to a common optical density, will be identical with regard to CF titer, nitrogen or Folin protein content. The CFU (complement-fixing units) per microgram protein (or nitrogen) was the same for both the Phase 1 and Phase 2 antigens. However, the yield of Phase 1 antigen from infected yolk sacs was about 4 times greater than the yield of Phase 2 antigen in spite of the fact that the phase 2 inoculum had an LD_{50} approximately 2 logs higher than the Phase 1. Possible reasons for this discrepancy have been discussed.

The antibody response of guinea pigs and rabbits immunized with either Phase 1 or Phase 2 organisms was studied by means of the CF reaction. Animals immunized with killed Phase 2 organisms will develop the homologous antibodies and also, if sufficient antigenic stimulation is provided, the heterologous Phase 1 antibodies. Phase 2 organisms, therefore, must contain Phase 1 antigen. Fewer Phase 1 organisms are necessary to provoke the appearance of Phase 1 antibody. It appears that the Phase 1 organisms either contain quantitatively more Phase 1 antigen or that the antigen is more accessible to the antibody-forming cells. Possible explanations for phase variation are discussed.

Both phase antigens were able to provoke intradermal reactions in guinea pigs previously immunized with C. burnetii (either phase). The skin reaction did not become positive until the appearance of Phase 1 antibodies in the circulation. A dual response to intradermal testing was observed in guinea pigs, the first reaction appearing in 24-72 hours and the second in about 7 days. The second reaction often was accompanied by induration and necrosis.

Microfilm $2.50; Xerox $7.80. 169 pages.

A STUDY OF ANTIGEN J IN THE BLOOD OF CATTLE

(L. C. Card No. Mic 59-5377)

Robert Albertus Elliott, Ph.D.
The Ohio State University, 1953

INTRODUCTION

In recent years greater emphasis has been placed on the blood typing of cattle by the breed associations as well as by the individual breeders. This emphasis has been due to the desire for proper identification and

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registration of the purebred animals within a breed. For such purposes it is necessary to have a better understanding of each of the antigen-antibody systems used in blood typing.

Todd and White[1] were the first to recognize the antigenic differences in the blood of cattle which could be detected by the use of isoimmune sera. Little[2] demonstrated antigenic differences by the use of normal serum from certain cattle, but could not place all cattle into definite groups on the basis of agglutination reactions. Ferguson[3] and Ferguson, Stormont, and Irwin[4] described 30 different antigenic components of the red blood cells of cattle, only one of which was detectable by normal serum. The red blood cells of animals show a great diversity in degree of reactivity when tested with normal sera. Stormont[5] proposed that the differences were only quantitative in nature.

Certain observations made on this system during the routine typing of the blood of cattle illustrated the need for a better understanding of this system. The present study was made in order to fulfill this need and to throw some light on the reasons for the great range in reactivity of red blood cells when tested with normal bovine sera.

MATERIALS AND METHODS

The red blood cells of animals were tested against the normal serum from two different animals. The hemolytic test described by Ferguson[3] was used.

The sera of 634 animals were tested for the presence of the normally occurring antibody and for the presence of the soluble J antigen. The antibody was detected by the use of the hemolytic test, J-positive cells being the indicator. The soluble antigen was detected by the use of an inhibition test in which the serum to be tested was mixed with a serum known to contain antibody. Following an incubation period, red blood cells known to possess the J antigen were added. The inhibition of hemolysis of the positive cells indicated the presence of the soluble antigen in the unknown serum.

The results of these tests were used to calculate the incidence of two specificities of the J antigen, the incidence of the soluble antigen, and the incidence of the naturally occurring antibody.

The antibody absorption technic was used on a number of normal sera in order to obtain fractionation into the two specificities.

The sera and red blood cells of 93 parent-offspring combinations were analyzed in a preliminary study of the inheritance of the components of the J system.

Isoimmunizations of animals possessing no detectable natural antibody, as well as animals possessing some natural antibody, were made by injection of J antigen in the form of whole blood, washed red blood cells, and cell-free plasma.

The heat stability of the soluble antigen and the natural antibody were studied by subjecting both to incubation over a wide temperature range.

The serum and red blood cells of the members of twin pairs were tested. The components of the J system possessed by one member were compared with the components possessed by the co-twin.

RESULTS AND DISCUSSION

The hemolytic test revealed that the red blood cells of 23.86 per cent of 1890 animals were reactive with a serum which was later designated reagent for J_1. The red blood cells of 34.46 per cent of these 634 animals reacted with a serum later designated anti-J_3.

The inhibition tests with the serum revealed that 55.36 per cent of the 634 animals tested possessed the soluble antigen. All animals whose red blood cells were reactive with the J_1 serum were reactive with the J_3 serum. The sera of these animals were also found to possess the soluble antigen. On the other hand, all bloods reactive with the J_3 serum were not reactive with the J_1 serum, but all animals possessing the J_3 antigen on the red blood cells also possessed the soluble antigen in the serum. The bloods of many animals whose red blood cells possessed no demonstrable antigen were found to contain the soluble antigen. This finding would tend to cast some doubt upon the validity of the statement by Stormont[5] that the red blood cells of any animal were capable of absorbing the antigen if placed in contact with a plasma containing the antigen. The present knowledge would suggest that the red blood cells of certain animals genetically have the ability to acquire the antigen but are genetically incapable of producing the antigen.

The titration of the normal sera revealed that 23.50 per cent of the animals tested possessed naturally occurring antibody. It was possible to place the sera of these animals in three groups on the basis of their reactivity when tested against the same bloods. The differences in the reactivity between certain bloods and certain sera were of such a magnitude that it was impossible to explain them on the basis of quantitative differences only. It was necessary to assume that there were qualitative differences and that the three groups of sera were capable of detecting three different antigenic structures. The absorptions of the sera representing the three groups further indicated the presence of more than a single specificity for the J antigen.

The absorption of a J_1 serum with any positive blood removed all of the antibodies from the serum. On the other hand, the absorption of a J_3 serum with certain bloods reactive with a J_3 serum, but not with a J_1 serum, produced an absorbed serum which now showed reactions very comparable to those obtained with a J_1 serum. Any reduction in the titer of the absorbed sera was explained on the basis that before absorption two antibodies in the serum were reactive with two antigenic structures on the red blood cell and following absorption one of these antibodies was removed. Thus there would be only a single antigen-antibody reaction where originally there had been two specific reactions taking place at the same time.

The results of the inheritance study indicate that it is possible for an animal to have the J_1 antigen when neither parent possessed that antigen. The parents possessed either the J_3 antigen or the soluble antigen. At the present time there is no explanation for these results. In no case did an offspring with either of the cellular antigens result from any mating unless one or the other of the parents also possessed the cellular antigen. A number of offspring with only the soluble antigen resulted from matings in which one or the other, or even both, parents possessed one of the cellular antigens.

A mating between two animals possessing the normal antibody can result in offspring with no demonstrable antibody. On the other hand, an offspring may possess antibody when neither parent had any demonstrable antibody.

The isoimmunizations with J antigen resulted in an increase in the amount of antibody in the serum of the

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recipient animal. The injection of whole blood resulted in an increase in the amount of J specific antibody in all animals, regardless of their original level of antibody. The increase in titer was evident after either the first or second injection and the titer began to fall shortly after the third and last injection. The antibody level in the serum of one animal, with an original titer of 1:16, remained at a level higher than the normal level. The injection of washed cells did not result in titer increases of a magnitude comparable with those obtained by the use of the whole blood. One animal did not respond to the stimulation until after the last injection, and then the increase was small and of short duration. The injection of cell-free plasma into one animal, with a small amount of normal antibody, resulted in a decrease in the amount of antibody, and during part of the study this animal showed no demonstrable antibody. The level returned to the pre-injection level after the last injection, showing a very small increase over normal on one titration, after which the level again returned to normal. One animal, immediately following the last injection, responded to the stimulation with plasma with an increase in the antibody level from a serum dilution of 1:16 to a serum dilution of 1:256. The antibody level remained at a dilution of 1:128 until the termination of the study.

The injection of plasma into an animal with no normal antibody elicited the production of antibodies specific for the J_1 antigen.

This evidence would suggest that those animals having neither cellular nor soluble antigen are capable of producing the antibody. The fact that some previous isoimmunizations have not resulted in the production of antibodies may be due to the recipient animals not being actually J-negative, but possessing soluble antigen. The differences in the antibody levels attained by various animals might be due to individual differences in ability to produce antibodies in general.

The stability studies indicate that the normal antibody responsible for the hemolytic reaction is as stable as immune antibodies and remains active when heated at 60^0 C for five minutes. Freezing and thawing and prolonged storage did not reduce the activity of the antibody. This evidence shows that the ability to cause lysis is more stable than the ability to cause agglutination, for Little[6] reported that the agglutinins deteriorated rapidly during storage. The soluble antigen was also found to be stable at room and refrigerator temperature and when heated at 60^0 C.

The study of twins revealed that those animals showing evidence of vascular anastomosis did not always possess a mixture of the components of the J system even when there was evidence of interchange of some of the other cellular antigens.

The evidence now at hand would indicate that certain of the previous concepts of the J system must undergo a change. It can now be seen that there are at least two specificities, with indications of a third, which can be demonstrated by the antibodies contained in different normal sera. The many differences which were at one time explained on the basis of being quantitative in nature can now be explained on a qualitative basis. The face that some of the sera can be fractionated by the proper absorption technics leaves little doubt of the qualitative nature of these differences.

Stormont[5] stated that only negative results had been obtained in efforts to produce an immune antibody specific for antigen J. In nearly all animals used in the present study the production of antibodies specific for antigen J was stimulated by the injection of the antigen. The use of cell free plasma as the source of antigen excludes the possibility of stimulating the production of antibodies for any antigen other than antigen J, for no other antigen has been found to be present in the plasma.

It would now appear that antigen J of the cells is under the influence of two genes. In this way one gene would control the production of the antigen and the other gene would control the ability of the red blood cells to acquire the antigen when it is present. This assumption would permit acceptance of the report by Stormont[5] of the acquisition of the antigen by J negative cells, as well as the fact that certain animals can possess the soluble antigen when no cellular antigen is demonstrable.

SUMMARY AND CONCLUSIONS

The study of the incidence of the J antigen and the fractionation of normal sera by absorption technics has demonstrated that the J antigen has at least two specificities demonstrable by normal sera.

A soluble antigen was demonstrated in the serum of many animals whose red blood cells had no cellular J antigen. The blood and serum of 634 animals was studied and it was found that 23.86 per cent had antigen J_1, 34.46 per cent had antigen J_3, 55.36 per cent had the soluble antigen, and 23.50 per cent possessed demonstrable natural antibody.

Isoimmunization, with the antigen in the form of whole blood, washed red blood cells, and cell-free plasma, produced antibodies specific for the J. antigen.

Microfilm $2.50; Xerox $4.00. 74 pages.

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Abstract published by special arrangement with The Ohio State University.

THE EFFECT OF TRYPSIN ON THE PATHOGENESIS OF TUBERCULOSIS

(L. C. Card No. Mic 59-5379)

Warren Eugene Engelhard, Ph.D.
The Ohio State University, 1953

The clinical application of the enzyme trypsin has given encouraging results when such pathological conditions as the following are present: where necrotic tissues are concerned,[5] as an adjunct to general surgical treatment of amputation stumps, decubitus ulcers,[4] second and third degree burns,[7] gangrene, sinusitis, and reduction from acute thrombophlebitis.[3] Because of the clinical success observed with this enzyme, an investigation was undertaken to elucidate the nature of the destructive process involved in the elimination of the tubercle bacilli from cases of tuberculous empyema after intrapleural lavage and debridement with trypsin.

First of all, it was observed by Reiser and his group[5] that trypsin administered intrapleurally as a therapeutic measure resulted in the destruction of these bacilli. Concentrations of approximately 2.5 mg/ml of trypsin accomplished this destruction. The present investigations, however, which were conducted to determine whether trypsin effected a direct destruction, indicated that concentrations of 2.5 mg/ml were inhibitory and 5 mg/ml were destructive against the bovine strain of Mycobacterium tuberculosis grown in Dubos medium. Furthermore, higher concentrations were also bactericidal, but they did not lyse cells, alter acid fastness, nor change cellular morphology. The cells did, however, lose the characteristic serpentine arrangement. In addition, growth studies in the presence of various concentrations of trypsin showed that trypsin also failed to accelerate growth in the lower dilutions, as Grab[2] had observed with the Staphylococci.

In this regard, it will be recalled, for example, that 500 mg of trypsin was the highest concentration tolerated intrapleurally.[6] Thus, in order to achieve direct killing of the tubercle bacilli, 5.0 mg/ml would be necessary. This concentration of trypsin would require instillation of 1,000 mg of trypsin daily. Such a concentration would not be without harmful effects to the patient. Other factors concomitant with trypsin are therefore probably involved in the destruction of the organisms in the intrapleural space. Other factors were investigated to try to determine tryptic action and its role in the destruction of the tubercle bacilli. These other factors included cell surface and permeability alterations, which are correlated with the cord or virulence factor.[1] In addition, the susceptibility of enzyme-treated bacilli to phagocytosis was compared with untreated organisms as another possible mechanism of the action of trypsin in tuberculous individuals.

A standardized quantity of washed tubercle cells was exposed to 400 mg of trypsin. The bacilli were mixed for a period of forty-eight hours. After such treatment the cells were washed three times in physiological saline and standardized again. The exposed cells were then mixed with basic fuchsin and incubated at 37 C for thirty minutes, one hour, and three hours. Examination of the supernatant after centrifugation indicated that with the treated organisms maximum uptake of dye occurred within thirty minutes. Furthermore, more dye was taken up by the treated cells, a characteristic which, as Bloch[1] indicated, denotes surface modification. On the other hand, very little uptake of dye was observed with the controls.

Previous investigators[1] have determined that the virulent tubercle organisms, namely, the human and bovine strains, do not decolorize methylene blue, but that the avirulent strains, such as BCG, decolorized methylene blue in fifteen minutes and the saprophytic strains, for example, Mycobacterium phlei, and Mycobacterium smegmatis, decolorized in three to five minutes. Bloch could induce virulent bacilli to decolorize methylene blue by extraction with petroleum ether. Surface components were thus removed to release intracellular enzymes and hence reduce methylene blue. Attempts were made to achieve similar results with trypsin and chymotrypsin acting as the surface degrading agents. Thus the washed virulent bacilli were exposed to trypsin and chymotrypsin and added to a mixture of 1 per cent glycerol or dextrose, an M/15 phosphate buffer, and a 1:20,000 dilution of methylene blue. Decolorization was complete in fifteen minutes with the chymotrypsin treated cells and in thirty minutes with the trypsin treated bacilli. Thus surface and permeability modifications were detected and verified.

Phagocytic studies of this difference were observed where both types of bacilli were exposed to rabbit macrophages in tissue culture. A standardized quantity of the treated and normal cells were exposed to tissue culture preparations of rabbit macrophages cultivated in Earl's solution containing 100 units of penicillin/ml.[8] The cells were exposed to the macrophages for forty-five minutes, and the results indicated that the enzyme exposed bacilli were taken up more rapidly and in larger numbers than the normal cells. For example, there were more macrophages which contained 10 or more treated organisms per cell than there were macrophages containing the same number of normal cells. Trypsinization, therefore, had effected an opsonization in that the trypsin treated cells were more readily ingested. No differences were noted in the capacity of the macrophages to destroy the treated cells.

Finally, when trypsin treated cells were used to infect animals, an extended survival time of fifteen days with mice and approximately four weeks with guinea pigs was noted. If, on the other hand, trypsin was instilled intranasally into infected mice as a therapeutic agent, an extended survival time of thirty days was observed. In addition, no change in the time of appearance and characteristic pathology was observed in the hypersensitive response initiated with trypsin treated and normal cells. However, guinea pigs localized and removed the intradermally injected trypsin treated cells more readily than the intradermally injected normal cells.

These investigations have established that the action of trypsin on tubercle bacilli, which probably accounts for their destruction in the intrapleural cavity, is probably due to modifications in the cells making them more susceptible to phagocytosis or other humoral factors rather than to the direct destruction of the organisms by the enzyme. Microfilm $2.50; Xerox $4.20. 80 pages.

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ANTIGEN-ANTIBODY DISSOCIATION PHENOMENA

(L. C. Card No. Mic 59-6705)

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The University of Texas, 1959

Supervisor: Dr. V. T. Schuhardt

Antibody sensitized erythrocytes (sheep) supplemented with additional nonsensitized erythrocytes at the time of addition of complement to the mixture, showed more hemolysis than could be accounted for by lysis of the originally sensitized cells. The addition of complement to a mixture of sensitized and nonsensitized cells in which the hemolytic activity had been stabilized resulted in a sudden increase in secondary hemolysis. These reactions indicate some transfer of antibody from the sensitized cells to the nonsensitized cells at the time of lysis of the former. Repeated addition of complement to mixtures of sensitized and nonsensitized cell preparations did not give convincing evidence of catalytic transfer of antibody in this system. Control difficulties in these studies resulted in the discovery that both sensitized and non-sensitized erythrocytes can be hemolytically damaged by centrifugation. This tended to cast doubt on the value of the results obtained in the transfer experiments. Diphtheria toxin (Tn), the toxicity of which has been neutralized by the addition of a minimum quantity of antitoxin (A), has been demonstrated by Pappenheimer and others to consist of a TnA_2 molecular ratio. The results reported here indicate that the neutrality of a TnA_2 mixture at the Lr/100 level can be reversed after 1 hour by the addition of 1 or more than 1 antigenic equivalent of diphtheria toxoid (Td). If the TnA_2 mixture is allowed to stand for 3 hours, 2 or more equivalents of Td were required for reversal. Excess antitoxin above the TnA_2 ratio resulted in increased difficulty of reversing the neutrality, in so far as the amount of toxoid required for this reversal is concerned. Centrifugal and gel diffusion evidence indicates that only a fraction of the toxicity of the original toxin present in the TnA_2 complex was liberated by the added toxoid. Efforts to prove that this fractional toxicity was due to free toxin, rather than the toxic poles of TnA complexes, were indicative, but not conclusive. Assuming the requirement for free toxin in in vivo toxicity, the reversal phenomenon at 2 equivalents of toxoid might be formulated as some approximation of the following:

$$n\,Tn + 2n\,A \rightleftharpoons n\,(TnA_2) \xrightleftharpoons{2n\,Td} \bar{n}\,(TnA_2) + \bar{n}\,\underline{Tn} + \bar{n}\,(TdA_2) + Td$$

A theory, based on hypothetical differences in binding avidity of different diphtheria toxin and/or toxoid molecules for antitoxin has been proposed as an explanation for the reversal phenomena observed in these studies. In this hypothesis the fraction of the previously neutralized toxin liberated by the addition of toxoid is visualized as less avid toxin which has been displaced from its terminal combination with antitoxin by more avid toxoid molecules. The variable avidity hypothesis also gives a logical explanation for the toxicity of an L^+ Dose and a 1/1 molecular ratio mixture of toxin and antitoxin, in contrast to the neutrality of a TnA_2 ratio mixture.

Microfilm $2.50; Xerox $5.00. 98 pages.

THE EFFECTS OF HETEROLOGOUS IMMUNE SERUMS UPON HELA CELLS IN VITRO AND RAT-HELA TUMORS IN VIVO

(L. C. Card No. Mic 59-4625)

Paul W. Grunmeier, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. L. I. Coriell

Heterologous immune serums against HeLa cells were prepared in rabbits, rats, and a tuberculin sensitive cow. The effect of these immune serums in vitro upon HeLa cells was studied by means of a cytotoxic metabolic inhibition test(CMI), the complement-fixation test, and by agglutination tests. The CMI test was sensitive, quantitative, and reproducible. The cytotoxic activity of the cow, rat, and rabbit immune serum was heat labile, removed by heating to 60°C. for 30 minutes, and restored by the addition of fresh unheated serum. The protective effect of the cow anti HeLa serum was demonstrated by the passive protection of HeLa tumors when studied by the quantitative and reproducible rat-HeLa tumor technique. Good correlation was obtained between the number of HeLa cells killed in the CMI test and the number killed in vivo in the rat-protection tests. The passive protection of the anti serum could be demonstrated when the serum was given either by the intraperitoneal route or by the intravenous route. By means of the CMI test the anti serum could be traced from the peritoneum into the extracellular fluid and a half life of approximately 1 day was determined for the antiserum. By adsorbtion of the

antiserum with HeLa cells or a water soluble extract of HeLa cells all the cytotoxic activity was removed when the serum was tested in the CMI test. When adsorbed with "normal" stable cell lines, first generation monkey or rabbit kidney cells, normal human cells, and malignant tissue there was only partial adsorbtion of the cytotoxic activity. When the cow anti HeLa serum was tested against various cell lines other than HeLa there was only limited activity against five of the twelve lines tested.

Suggestive evidence that the cytotoxic activity of the cow anti HeLa serum is due to anti body are 1) cytotoxic activity is not present in normal sera, 2) cytotoxic activity increased progressively after repeated exposure of the animal to the HeLa antigen, 3) the rising titer of cytotoxic activity was paralleled by a rising titer when tested by agglutination test or by complement fixation test, 4) the presence of cytotoxic activity was demonstrated by in vivo passive protection tests, 5) the activity was contained in the gamma globulin fraction of the serum, 6) the activity was completely adsorbed by HeLa cells but only partially adsorbed by other cell lines or fresh tissue.

The data suggest that cytotoxic antibody is formed to the one cell studied, that this antibody is capable of crossing capillary membranes, that this heterologous cytotoxic antibody can prevent at least one type of experimental human tumor, and that new quantitative in vitro and in vivo tests are now available for exploring the mechanism of tumor rejection.

Microfilm $2.50; Xerox $3.00. 52 pages.

AN INVESTIGATION OF THE DEPOLYMERIZATION OF CHONDROITIN SULFATE BY VARIOUS MICROORGANISMS

(L. C. Card No. Mic 59-5383)

Donald Andrew Harvey, Ph.D.
The Ohio State University, 1953

In recent years there has been an increased interest in connective tissues in general and especially in the interfibrillar material of connective tissues. While the chemistry of connective tissue is not completely known, chondroitin sulfate and hyaluronic acid have been identified as mucopolysaccharide components of the interfibrillar material. Several types of chondroitin sulfate have been isolated which differ in optical rotation, alcohol solubility, and the rate of hydrolysis by testicular hyaluronidase.[1,2] The chondroitin sulfates on acid hydrolysis yield equimolar quantities of glucuronic acid, chondrosamine (2-amino-2-desoxy-D-galactose), acetic acid, and sulfuric acid. The chondroitin sulfates and their enzymatic hydrolysis have been studied much less extensively than hyaluronic acid and hyaluronidases. This difference is due, in part, to the slower rate of enzymatic hydrolysis of chondroitin sulfate which makes the detection of the chondroitinases more difficult. The purpose of the investigation was to determine possible bacterial sources of chondroitinase and to study methods for the detection of these enzymes.

MATERIALS AND METHODS

Source of Mucopolysaccharides

Chondroitin sulfate from cartilage was prepared by the method of Einbinder and Schubert.[3] This chondroitin sulfate was further fractionated into the head fraction, the mid fraction, and the tail fraction chondroitin sulfates.[2] Chondroitin sulfate from skin and hyaluronic acid were prepared from pig skin according to the procedure of Meyer and Chaffee.[4] Heparin prepared by the Connaught Medical Research Laboratories, University of Toronto, was used. Samples of chondroitin sulfate were also furnished by M. L. Wolfrom, Department of Chemistry, The Ohio State University.

Determination of Chondroitinase Activity

Turbidimetric method. The turbidity reducing method of Mathews, Roseman and Dorfman[5] was employed to determine chondroitinase activity. The supernatant broth of centrifuged cultures was used as an enzyme source.

Decrease of chondroitin sulfate. A modification of the turbidimetric method was used to determine the decrease of chondroitin sulfate in culture media during the growth of microörganisms. The supernatants of centrifuged cultures containing chondroitin sulfate were used as the test material.

Sulfate determination. The inorganic sulfate from the depolymerization of chondroitin sulfate was determined turbidimetrically as barium sulfate. Excess barium chloride was added to acidified culture supernatants from the barium sulfate.

RESULTS AND DISCUSSION

It is impossible at the present time to classify enzymes hydrolyzing mucopolysaccharides on the basis of the specific linkage cleaved, and therefore they are identified according to their source and substrate. Thus while the term chondroitinase is used to denote the enzymes which hydrolyze chondroitin sulfate, the nature of the reaction catalyzed is unknown because of the lack of knowledge concerning the chemical structures of the various chondroitin sulfates.

Cartilaginous chondroitin sulfate was broken down by coliforms, pseudomonads, streptococci, an erysipelothrix, and several mixed cultures. The turbidimetric assay of these cultures on chondroitin sulfate from skin, however, revealed chondroitinase activity with only one mixed culture. No organisms isolated in pure culture were found to hydrolyze the chondroitin sulfate from skin. A difference in the enzymatic hydrolysis of skin and cartilaginous chondroitin sulfates might be expected since testicular hyaluronidase has been shown to hydrolyze chondroitin sulfates from cartilage but not from skin.[1]

Although this is the first time bacterial chondroitinase activity has been demonstrated by the turbidimetric method, relatively large amounts of chondroitinase were produced only when the organisms were grown in cooked meat medium. While cooked meat medium provided the necessary conditions for enzyme production, it had certain disadvantages when used with the turbidimetric assay procedure. Cooked meat medium contained substances which produced a turbidity with acidified albumin. However, the majority of organisms which produced chondroitinase

caused a 40 to 60 per cent reduction of this turbidity when grown in this medium. Because of this reduction in turbidity, it might be expected that one of the materials present in cooked meat medium was chondroitin sulfate which was probably extracted from heart tissue during the preparation of the medium. Furthermore, several of the organisms produced substances which also gave a turbidity with acidified albumin. While these variations in turbidity were accounted for by controls, the accuracy of the method was not as great, since the increased turbidity could not be determined as accurately as a solution of lower optical density. Variations up to 15 per cent were found when the procedure was duplicated. The turbidimetric method under ideal circumstances has an accuracy of approximately 5 per cent. However, the test as used in this and in other investigations cannot be expected to attain this accuracy when crude enzyme preparations are used. Even when positive results were obtained by the use of the turbidimetric method, the small amount of activity usually obtained indicated the need for a more sensitive test to detect chondroitinase activity.

The failure to demonstrate chondroitinase by the turbidimetric method cannot be interpreted as definite evidence that no specific enzyme is present. This is best shown by several pseudomonads and molds which were capable of utilizing chondroitin sulfate as a sole source of carbon and which also caused a marked decrease in the concentration of chondroitin sulfate in culture media. However, they produced no chondroitinase in quantities that could be determined by the turbidimetric method.

The small amount of hydrolysis of chondroitin sulfate, or probably more accurately, the slow rate of hydrolysis of chondroitin sulfate, places a serious limitation on methods that may be used to determine the enzymatic hydrolysis of chondroitin sulfate. Our almost total ignorance of the products of chondroitinase activity makes methods such as reducing sugar and amino sugar determinations of dubious accuracy. A determination of the decrease in the concentration of chondroitin sulfate in culture media as an index of chondroitinase activity proved to be the best procedure to detect chondroitinase from bacterial sources.

The validity of the test for a decrease in the concentration of chondroitin sulfate in culture media as an index of enzymatic activity is best shown in the use of several related mucopolysaccharides. The differences obtained in the decrease of the various mucopolysaccharides in culture media demonstrated a selective action by the organisms. Granting the validity of the method, this offers a technique to determine the specificity of the enzymes involved. The same enzyme in testicular mucopolysaccharase preparations is thought to be responsible for the depolymerization of both chondroitin sulfate and hyaluronate.[5,6] This means that chondroitin sulfate and hyaluronate have the same type of linkage. In this investigation three streptococci were found to cause a decreased concentration of both chondroitin sulfate and hyaluronate. This may have been due to different enzymes, but on the basis of the results noted with testicular hyaluronidase, it could also quite possibly be the same enzyme that acts on the same linkage in both molecules. The coliforms, pseudomonad and proteus, on the other hand, had no effect upon hyaluronate although they caused a decrease in chondroitin sulfate. These organisms therefore hydrolyze a linkage of chondroitin sulfate not contained in hyaluronate.

Likewise, variations in the decrease of the concentration of the various chondroitin sulfates were noted which seemed to indicate a difference in the linkages of these chondroitin sulfates. The variations obtained in the degree of hydrolysis of the chondroitin sulfates do not indicate that the differences in the chondroitin sulfate are merely due to the length of the polymer or to the method of preparation of the chondroitin sulfate.

The differences in the results obtained with the mid and tail fraction chondroitin sulfates deserve further comment. The mid fraction occurs in the highest concentration in cartilage and undoubtedly accounts for the majority of observations that have been made with cartilaginous chondroitin sulfate. This mid fraction may be obtained in crystalline form as a calcium salt, lending support to the concept of the linearity of the chondroitin sulfate polymer. It would seem likely that the mid fraction would give an orderly x-ray diffraction pattern, whereas unfractionated chondroitin sulfates have been shown to give unorderly x-ray patterns. The tail fraction chondroitin sulfate, which differs from the mid fraction in solubility and optical rotation, probably has some linkages that are different from those of the mid fraction. This hypothesis is supported by the results obtained which indicated that the tail fraction was not affected to the same extent as the mid fraction chondroitin sulfate. Hydrolysis of both of these fractions by the same organisms indicated that the tail fraction had some linkages which are the same as in the mid fraction. On the basis of these limited results it seems possible that the tail fraction is a chondroitin sulfate with side chains.

The one product of the enzymatic hydrolysis of chondroitin sulfate that is known is inorganic sulfate.[7] A method of determining small amounts of sulfate was developed so that this procedure could be used concurrently with the detection of a decrease of chondroitin sulfate in culture media. The inorganic sulfate liberated by Proteus and a Pseudomonas roughly paralleled the decrease of chondroitin sulfate in culture media. The reactions of enzymes on chondroitin sulfate do not always result in free sulfate, however. It has been shown that inorganic sulfate is not liberated in the hydrolysis of chondroitin sulfate by testicular hyaluronidase[6] and the results in this investigation indicated that no sulfate was produced by streptococci and erysipelothrix. Although evidence is lacking, it would be expected that the depolymerization of chondroitin sulfate and the liberation of inorganic sulfate would be due to different enzymes. From the formulas suggested for chondroitin sulfate, the removal of sulfate would not be expected to cause the depolymerization of chondroitin sulfate. It is interesting to note in this connection that Meyer[8] believes the slower rate of hydrolysis of chondroitin sulfate by testicular hyaluronidase is due to the more strongly polar nature of the sulfate. The hydrolysis of chondroitin sulfate may be facilitated by the removal of sulfate by enzymes from organisms such as pseudomonas and proteus. Similarly, the activity of mixed cultures which cannot be demonstrated with pure cultures could also quite possibly be due to a synergistic reaction of enzymes from different microörganisms acting upon different linkages in the chondroitin sulfate polymer.

One of the main problems in research on chondroitinases has been in the detection of these enzymes. The data presented in the investigation revealed several new bacterial sources of enzymes which will depolymerize

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

chondroitin sulfate and modifications of methods which may be used to detect these enzymes.

Microfilm $2.50; Xerox $5.00. 97 pages.

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STUDIES ON SOME METHANE-UTILIZING BACTERIA

(L. C. Card No. Mic 59-6718)

Edward Renton Leadbetter, Ph.D.
The University of Texas, 1959

Supervisor: J. W. Foster

Using virtually pure methane as the substrate in liquid enrichment cultures and in agar direct platings, some 30 bacteria have been isolated in pure culture. Each was able to grow in a mineral salts medium with methane as the sole source of carbon and energy. The cultures -- morphologically indistinguishable, polarly monoflagellated, gram negative pseudomonads -- differed with respect to colony appearance, and comprised four groups with respect to pigmentation: different shades of pink, of brown, of yellow, and unpigmented. Each of the organisms was obligately dependent on methane (or methanol) for growth, being unable to utilize a great many other conventional hydrocarbon and non-hydrocarbon substrates. Growth in the presence of methane and C^{14}-labeled amino acids and glucose indicated, however, that the radioactive compounds were extensively metabolized. Experiments employing $C^{14}O_2$ indicated substantial assimilation of CO_2 during growth in methane, and that the metabolism of these organisms is heterotrophic. In manometric experiments, the organisms oxidized n-alcohols to the corresponding carboxylic acids.

The different shades of pigmentation within each of the respective pigmented groups are due to concentration differences of an individual pigment -- the absorption spectra and solubility characteristics of which are typical of carotenols. The absorption spectra of suspensions of living cells of the differently pigmented groups were recorded in order to facilitate identification of these methane-utilizing bacteria in the near future.

Inasmuch as each of the pigment groups spontaneously mutates to another, pigmentation is considered to be a varietal rather than a species character in these organisms. Their obvious homogeneity indicates they are one species comprising 4 varieties: pink--Pseudomonas methanica (Sohngen); yellow--Pseudomonas methanica var. fulva; brown--Pseudomonas methanica var. fusca; non-pigmented--Pseudomonas methanica var. incolorata.

The ability of these organisms to oxidize hydrocarbons they cannot utilize for growth has led to the accumulation and isolation of a number of intermediate compounds in hydrocarbon oxidation. From ethane, ethanol, acetaldehyde, and acetic acid, were obtained; from propane, n-propanol, acetone, and propionic acid; and from n-butane, n-butanol, 2-butanone, and n-butyric acid.

By employing ethane-d_6 (deuteroethane) it has been possible to eliminate olefin formation as a major event in the oxidation of ethane. The use of O_2^{18} has established that cells growing on hydrocarbons incorporate a substantial amount of molecular oxygen in their cellular compounds, while the same cells growing on non-hydrocarbon substrates derive a much smaller percentage of their cellular oxygen from molecular oxygen.

These data are consistent with a mono-terminal pathway of hydrocarbon oxidation:

$$\text{hydrocarbon} \rightarrow ? \xrightarrow{O_2} ? \rightarrow \text{primary alcohol} \rightarrow \text{aldehyde} \rightarrow \text{carboxylic acid} \rightarrow \text{carbon dioxide.}$$

The possible significance of methyl ketone formation is discussed, as are also possible intermediates between the hydrocarbon and primary alcohol.

Microfilm $2.50; Xerox $5.60. 113 pages.

PHYSICO-CHEMICAL CHANGES INDUCED IN CASEIN BY STREPTOCOCCUS AGALACTIAE

(L. C. Card No. Mic 59-5364)

George William Malaney, Ph.D.
The Ohio State University, 1953

While the chemical changes produced by microorganisms have been the object of numerous investigations since the early days of the science of bacteriology and have, in some instances, been established as criteria for the identification and classification of microorganisms, the physical and physico-chemical transformation mediated by bacteria, yeasts, and molds have been largely neglected.

Biochemical changes induced by microorganisms — possibly including physical alterations — have a practical as well as theoretical significance from several different points of view. For example, such considerations are of interest to workers in the fields of food bacteriology and food technology. As is well known, certain microorganisms produce desirable changes in food products, for

instance, the ripening of cheese. Other microorganisms —the so-called spoilage organisms—produce changes in the constituents of food which render it unfit for human consumption.

Another important aspect of the subject is that of disease production in man and animals in which physical changes may play a part. Relatively little is known of the mechanism by which microorganisms produce disease. Of the pathogenic organisms a few are known to produce their harmful effects through the elaboration of toxic chemical substances. The way in which the toxin interferes with normal physiologic function of the animal body, however, has not yet been clearly established. For other parasitic organisms knowledge of the pathogenic mechanism is even more limited. It is not unreasonable to postulate that some organisms exercise a deleterious effect by upsetting the equilibrium existing between the colloidal constituents of tissue cells and fluids, perhaps by altering the physical character of an essential component.

The changes induced by Streptococcus agalactiae are important to the food technologist and to the animal pathologist. The natural habitat of the organism is cow's milk, one of man's most valuable foods. Growth of this organism in milk may induce significant changes in the milk constituents, thus making it unsuitable for the manufacture of butter and cheese. From the veterinary standpoint it is considered the principal causative agent of bovine mastitis, an infection of great economic significance to the dairy industry.

The object of the dissertation was the determination of physico-chemical alterations produced by S. agalactiae in the casein of cow's milk. Certain of the methods of physical chemistry, particularly the electrophoretic technique, were applied to this problem.

The experimental results showed that S. agalactiae is able to induce at least two significant changes in the casein of cow's milk: first, a reduction in solubility; and, second, a change in the relative concentrations ("redistribution") of the electrophoretic components of casein. These changes appear to be mutually related since marked alterations in the relative concentrations of the components occurred only in samples in which the solubility had been greatly reduced.

The redistribution revealed itself as an increase in the relative concentration of β- or γ-casein, accompanied by a proportionate decrease in the relative concentration of α- or β-casein, respectively. The values obtained for the distribution of free amino groups by formol titration indicate that the changes are undoubtedly not the result of protein hydrolysis. It seems probable that the changes observed are physical rather than chemical in nature.

It is suggested by the writer that the shift in the proportions of α-, β-, and γ-casein is a disaggregation reaction involving α-β and β-γ complexes. The overall reaction might be expressed in equation form as

$$\alpha\text{-}\beta \text{ complex} \rightleftharpoons \alpha\text{-casein} + \beta\text{-casein}$$

$$\beta\text{-}\gamma \text{ complex} \rightleftharpoons \beta\text{-casein} + \gamma\text{-casein}$$

The metabolic processes of S. agalactiae force both reactions to the right. Upon removal of the influence of the organism, the reactions apparently move back in the direction of greater aggregation, i.e., to the left. It seems probable that a second factor is operative in changing the proportions of the casein components. It is reasonable to postulate that the poorly-soluble α-casein, once dissociated from the β-casein, precipitates to some extent, thus further increasing the relative concentration of β-casein.

The components of the inoculated samples in general exhibited lower electrophoretic mobilities than did the components of the corresponding uninoculated controls. Denaturation, i.e., an unfolding of the protein chains followed by a random refolding upon itself or another protein, is a possible explanation of the observed decrease in mobilities.

The reduction in casein solubility apparently derives from two factors: (1) denaturation of one or more components, and (2) low solubility of α- and possibly γ-casein when dissociated from β-casein.

This hypothesis leads to certain conclusions concerning the nature of the electrophoretic components of casein. The experimental results suggest that the electrophoretic peak taken routinely to represent pure α-casein actually represents α-casein aggregated with 10 to 20 per cent of β-casein, whereas the so-called β-casein is, in fact, β-casein complexed with 40 to 50 per cent of γ-casein.

The hypothesis agrees very closely with the theory advanced by Linderstrøm-Lang[1] in connection with an attempt to elucidate the nature of casein. He suggested that one of the casein components must act as a protective colloid for the dispersion of calcium caseinate as it exists in milk.

It is postulated that β-casein is Linderstrøm-Lang's protective which maintains α-casein and possibly γ-casein in solution in milk. If the protective β-casein is removed by disaggregation, as by bacterial action, the α-casein, having a low solubility, precipitates. It is also possible that the modified β-casein, as bacterial growth continues, is denatured, becomes highly adsorptive, and promotes the eventual precipitation of all components.

It is evident that S. agalactiae is capable of markedly affecting the association-dissociation composed of the components of casein. Although the significance of such systems in the normal economy of the tissues has not been elucidated, there seems little reason to doubt that they play an important role. An association or dissociation produced by an external agency would produce a disequilibrium which would interfere with the normal functioning of the tissue cell or fluid, leading to the development of a pathologic condition. If the external agency were a microorganism, then this adverse effect upon the association-dissociation equilibrium must be considered a pathogenic mechanism of that organism.

Microfilm $2.50; Xerox $4.40. 84 pages.

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PHYSICO-CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF THE HEAT-STABLE ANTIGEN EXTRACTED FROM TISSUE OF ANIMALS INFECTED WITH BACTERIUM TULARENSE

(L. C. Card No. Mic 59-6607)

William Thomas Northey, Ph.D.
University of Kansas, 1959

Larson (1) has described a heat-stable antigen in the tissues of animals which have died of tularemic infection. Separation of the antigen from the animal tissues is accomplished by heating minced tissues at 100° C. in a 0.85% salt solution for 30 minutes. The antigen is recovered in the supernatant following centrifugation of the heated extract to remove the heavier tissue fragments. In these studies, further purification and concentration of the antigen has been effected by precipitation with methyl alcohol and it has been obtained in a high degree of purity following ultra-centrifugation at 40,000 R.P.M. for 5 hours. The sediment obtained from ultracentrifugation consists of a gelatinous material which, when examined under the electron microscope, appeared as filamentous strains consisting of cell wall material. In this respect, the tissue antigen very closely resembles the preparation obtained by Shepard, et. al. (2) by means of extraction of culture cells with ethyl ether. Chemical analysis on the tissue antigen showed it to consist primarily of a polysaccharide material of which an important part was composed of glucosamine and/or N-acetylglucosamine. In addition to these and presumably other sugars, there exists a small amount of phosphorous and a fairly large lipid fraction. Examination of this antigen for protein content by means of paper electrophoresis, paper chromatography, and ultracentrifugation indicates that the protein material present does not contribute to the serological activity of the antigen, but rather is an impurity remaining in the antigen preparation as a result of incomplete purification. Removal of the lipid portion by chloroform extraction with or without hydrolysis with 0.1 M acetic acid, indicates that the serological activity, at least in terms of hemagglutination-inhibition activity, is not a function of the lipid portion. It appears very likely that the antigen preparation contains some phospholipid material which is part of the cell wall, but that the serological specificity of the antigen resides in the polysaccharide moiety. Comparison of the tissue extracted antigen from animals dead of tularemia, with an antigen prepared from concentrated cells grown in culture and extracted by the same procedure, i.e., boiling in 0.85% NaCl for 30 minutes, indicates that the antigen obtained in this manner is essentially similar to that obtained from tissues. On the basis of this finding it appears that the "Ascoli"-type antigen, at least in tularemia, constitutes the recovery from infected tissues, of cell walls remaining from the massive infection characteristic of tularemia. This is in accord with the finding of Downs, who has shown that the tissue antigen could not be recovered from animals infected with tularemia until the organism reached a concentration of 10^8 in the tissues. The inability of the crude tissue extract to sensitize sheep red blood cells to specific agglutination by antiserum is likely attributable to the lower concentration of the antigen in these extracts.

Comparison of the erythrocyte sensitizing capacity of the saline-heat culture extracts, indicate that the ability to sensitize SRBC may reside in a capsular-like antigen which is found in greater abundance in the more virulent strains. Enzymatic action by a large and representative number of enzymes showed little activity toward the highly-stable antigen. Only in the case of B-glucuronidase was some slight degree of activity noted. Preparation of an osazone resembling that formed by galacturonic acid gives a clue to the identity of at least part of the antigenic mosaic.

Studies on the immunogenic properties of the antigen revealed that a fair degree of protection could be achieved against experimental infection of white mice. Significant protection in terms of prolongation of life was seen in the mice challenged with the highly-virulent Sm-4 (Schu). An even greater protection was found when the immunized animals were challenged with the virulent 425 strain. A comparison in terms of immunizing efficacy between the heat-saline culture extracted antigen and the heat-stable tissue antigen showed that essentially similar protection could be obtained. Antigenicity studies showed that the tissue antigen was capable of inciting antibody formation in several representative laboratory animals, and that this antibody production could be demonstrated serologically in terms of hemagglutinating, agglutinating, precipitating, and complement-fixing antibodies. Physical analysis both of the tissue antigen and the saline-heat culture antigen by means of infra-red absorption gave patterns differing only in degree. Biological analysis by means of the quantitative precipitin reaction indicated that there remains some impurity even in the "purified" antigen preparation. Evidence of toxicity of this antigen similar to that found in certain members of the gram negative group was not forthcoming.

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Microfilm $2.50; Xerox $5.80. 117 pages.

STUDIES ON A RED PIGMENT PRODUCED BY PSEUDOMONAS AERUGINOSA

(L. C. Card No. Mic 59-5957)

Frederick Just Post, Ph.D.
Michigan State University, 1958

Major Professor: W. L. Mallmann

An organism has been isolated from soil which produces a water soluble red pigment. The organism has been identified as a variant of Pseudomonas aeruginosa var. erythrogenes (Gessard). The wine red pigment was later termed pyorubrin and it has been reported occasionally by various authors since that time.

The cultural requirements for the production of the red pigment have been determined and it has been found that a medium composed as follows gives the best results:

DL-alanine	1.0%
$MgSO_4.7H_2O$	0.5%
glycerol	0.3%
K_2HPO_4	0.01%

pH 7.0

A procedure has been demonstrated for isolating the red pigment from synthetic media. Because of the fact that the pigment is soluble only in water, methyl alcohol, phenol and acetic acid, the procedure involves precipitating the pigment on a powdered cellulose column and washing with various solvents. This treatment is followed by chromatographic separation from various contaminants on powdered cellulose columns using methyl alcohol and 1N NH_4OH as solvents.

In characterizing the pigment it was found that it had E_{δ} at pH 8.0 of +0.215 volts. It was also found that the pigment could act as an electron acceptor in the succinic dehydrogenase system of yeast. It has further been noted that the pigment has four distinct absorption peaks at 234, 281, 390, and 515 mu at pH 8.0.

It was discovered that the pigment, as isolated from culture, was altered in strong base (1N NaOH; very poorly if at all in NH_4OH) in such a way that it now became a very effective indicator. The color of the original pigment changed slightly toward a violet color below pH 3.0 but remained red at all pH's above 4.0. The altered pigment retained the acid characteristics but now became orange-yellow above pH 4.0.

The possibility that some group is removed from the molecule by the action of the base is discussed, and absorption spectra for all of the pigments derived from the one isolated are included.

The theory that the red pigment is a derivative of the phenazine nucleus is advanced on the grounds of the similarities of absorption spectra with the phenazine pigments, its chemical reactions, and finally by consideration of the fact that the organisms, to which these isolated belong, characteristically produce phenazine pigments.

An organism obtained from the National Collection of Type Cultures, London, and identified as Ps. aeruginosa var. erythrogenes on the basis of pyocyanine production, also produced a red pigment identical with that obtained in the present studies. The identification of the organisms, by other means, used in this study is therefore verified. Microfilm $2.50; Xerox $7.20. 151 pages.

MUTANT INDUCTION DURING THE DIVISIONAL CYCLE IN BACTERIA

(L. C. Card No. Mic 59-6723)

Verne Alden Ray, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Orville Wyss

This study has attempted to correlate periods of sensitivity to the mutagenic action of ultraviolet light (UV), with various stages of macromolecular synthesis and cellular division. Bacterial cells were prepared in such a manner so as to be in a more defined physiological and divisional state than has hereto been achieved. A membrane filter technique has been developed which allows one to carry out all manipulations involved in the treatment of cultural samples, up to the time of mutant expression, within a 3 min period.

The mutation frequency of high-level (1 mg/ml) streptomycin resistant mutants, induced by a low dose (100 ergs/mm^2) of UV in a synchronously dividing culture of Escherichia coli B/r, was not constant throughout the divisional cycle. Log-phase cells grown on minimal media and irradiated on membrane filters, exhibited two peaks of mutation frequency in the interdivisional phase. One peak occurred at 10-15 min and the other at 25-30 min in a culture that doubled its number in approximately 40 min.

The first peak which was always greater than the second, occurred at a time when the culture was most sensitive to the lethal action of UV. This period was also found to be one characterized by a marked synthesis of both deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). The sensitivity of cells to both the lethal and mutagenic action of UV, can thus be partially attributed to the intensive synthesis of nucleic acid.

The second peak of mutation frequency which occurred in the period of greater sensitivity to the lethal action of UV, was also associated with a burst of DNA synthesis. At this time, RNA synthesis had leveled off and was proceeding very slowly. Therefore, increases in mutation frequency were closely correlated with bursts of DNA rather than RNA synthesis. Both peaks of mutation frequency were due primarily to increases in the streptomycin dependent and slow growing streptomycin resistants types.

A third peak of mutation frequency occurred following division, and was comparable both in time of appearance and in intensity to the first or 10 min peak. However, a considerable number of mutants were induced when the cells were least sensitive to the mutagenic and lethal action of UV. Rapid DNA synthesis only added an additional fraction. In experiments of phosphate deprival, where growth was proceeding at a very slow rate, approximately half the number of mutants of peak periods were still induced.

The periods of DNA synthesis, which occurred during at least 50 per cent of the divisional cycle, probably were conditioned by the alternation of temperature technique of obtaining synchronous cultures. RNA synthesis in such cultures was most intensive during the 10 min period following cell division and then proceeded at an extremely slow pace.

Yeast extract supplementation (5 mg/ml) prior to irradiation caused a marked increase in the mutation frequency. This increase was duplicated by a mixture of ribonucleosides (10 μg/ml of each) and amino acids (0.4 mg/ml). At the same concentration, neither of these supplementations alone could duplicate the increase. Supplementation with a mixture of vitamins, individual vitamins, RNA purines and pyrimidines, ribonucleosides, ribonucleotides, and deoxyribonucleosides failed to duplicate the yeast extract response. Supplementation with an enzymatic digest of casein (5 mg/ml) produced a greater increase in mutation frequency than yeast extract.

The result with the ribonucleoside and amino acid

mixture, plus the observation that 6-azauracil supplementation caused a marked decrease in the mutation frequency during the early part of the divisional cycle, tended to implicate RNA in the mutagenic process. The relationship between these observations and a possible mechanism for the action of UV in inducing mutation is discussed. Microfilm $2.50; Xerox $4.60. 90 pages.

IN VIVO AND IN VITRO STUDIES OF POLIOVIRUS TYPE I

(L. C. Card No. Mic 59-6609)

John L. Riggs, Ph.D.
University of Kansas, 1959

A group of monkeys which had been fed poliovirus was sacrificed at varying time intervals and a series of tissues was removed, quick frozen, sectioned and stained with fluorescent antibody to determine the site of initial multiplication and means of spread of the virus to the CNS. It was concluded by comparison of the negative results obtained with the fluorescent antibody technique with those obtained by Dr. H. A. Wenner using the TCD_{50} method of viral assay, that the labeled antibody technique was not sensitive enough to detect the virus in the tissues.

HeLa cells in continuous culture were utilized to study the sequence of events of the infection with poliovirus at varying time periods after inoculation. A determination of the time of formation of infectious virus was made which showed that the majority of new virus is produced between the 4th and 6th hr after inoculation. The effects of ribonuclease on the virus at the 9th hr after inoculation was determined and the conclusion drawn that the enzyme had no effect upon the infectivity of the virus, indicating complete virus was present at this time.

Infected coverslip cultures which were fixed in acetone at varying times after inoculation with poliovirus were utilized in staining with fluorescent antibody to determine the time of formation and morphological changes of the antigen within the cells. Diffuse staining of the cytoplasm was observable at 3 hr, and an increase in the antigenic material being stained was evident up to the 7th hr period. At 9 hr small, punctate, brightly fluorescent areas were evident in the cytoplasm of infected cells. No intranuclear staining was evident at any time period.

Infected coverslip cultures which were fixed in Newcomer's fixative at various time periods after inoculation with poliovirus were stained by a variety of histochemical stains, including acridine orange to differentiate DNA and RNA, methyl green-pyronin for differentiation of DNA and RNA, the Feulgen technique for DNA, and the May-Gruenwald-Giemsa stain for general morphological changes.

Infected coverslip cultures which were fixed in Newcomer's fixative were also digested with ribonuclease before staining with acridine orange or methyl green-pyronin to act as an enzyme control and to determine if complete virus present in the cells could be stained by this method.

Cellular alterations were noted by using these staining methods at 5 hr after inoculation with two plaque forming units of poliovirus per cell, and at 18 hr after inoculation with 100 TCD_{50} of the virus. With the larger inoculum, the changes included an increased staining of the RNA moiety of the infected cells, with concurrent pycnosis of the nucleus. By the 9th hr, no further alterations were noted. With the smaller inoculum, small plaques were formed which increased in size at later time periods. Cells within these foci of infection were noted in different stages of infection, indicating a progressive cell to cell infection from the center of the plaque.

The cells which were treated with ribonuclease before staining with acridine orange or methyl green-pyronin showed no RNA present within the cell.

Basophilic intracytoplasmic granules were noted in the infected cells stained with May-Gruenwald-Giemsa, although the general morphology, distribution, number, and size of these inclusions did not indicate that they were made up of viral particles but did indicate, more probably, alterations of the cytoplasmic cellular components due to the infection. Microfilm $2.50; Xerox $5.20. 104 pages.

DIMORPHISM IN PATHOGENIC FUNGI

(L. C. Card No. Mic 59-6827)

John Willard Rippon, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

The phenomenon of dimorphism delineates most fungal pathogens of man into superficial and deep invading organisms. It appears that the ability of a fungus to assume a yeast-like growth phase is required for the invasion of deep tissues and organs. Conversely the lack of this ability limits an organism to superficial infections.

The physiological basis of dimorphism was studied in the present work from three aspects. (1) The known conditions necessary for mycelium to yeast conversion in normally dimorphic fungi were applied to dermatophytes to ascertain an induced morphologic change and to determine whether it would be associated with an increase in pathogenicity for deep tissues of animals. (2) The response of the normally dimorphic fungus Histoplasma capsulatum to in vivo existence at less than mammalian body temperature was studied using experimental histoplasmosis in poikolothermic animals. (3) The effect of extracts of the yeast Saccharomyces cereviseae on both cultural phases of the dimorphic fungus Histoplasma capsulatum at various temperatures was observed to assess any chemical component inducing dimorphism at less than 37° C.

1) In a series of experiments it was demonstrated that if the dermatophytes Trichophyton rubrum, Microsporum audouinii, and Cladosporium mansonii are induced, in vivo and in vitro, to assume a yeast-like morphologic alteration, an associated increase in invasive ability for deep organs occurs. The in vitro transformation was accomplished by growing the organisms on gradient tilt plates against increasing concentrations of cysteine at 37° C. In vivo transformation was accomplished when the normal mycelium, contained in a dialysis bag, was implanted into the peritoneal cavity of rabbits. The injection of in vivo or in vitro altered organisms into the peritoneum

of mice resulted in numerous lesions on the liver, kidneys, and throughout the peritoneal cavity. These lesions resembled mycotic granulomas with unicellular budding forms consistently found on stained preparations.

2) Poikolothermic animals (100 frogs, Rana pipiens; 24 lizards, Sceloporus undulatus) were injected with saline suspensions of yeast phase and mycelial phase H. capsulatum, and incubated at 25°, 30° and 37° C. Frogs injected with M or Y phase, incubated at 25° or 30° C. and autopsied at the ends of one and two weeks, showed organ infection in all cases. Stained smears demonstrated the presence of mycelium only throughout the lesion regardless of the cultural phase injected. Groups of lizards injected with M or Y phase were incubated at 25° or 37° C. and autopsied at death or in three weeks. Lizards incubated for three weeks at 25° C. showed infection as mycelial lesions on liver and spleen, regardless of cultural phase injected. Conversion to yeast phase occurred in lizards injected with M phase incubated at 37° C.; the lesion material showed mycelial elements along with free and phagocytized yeast cells.

3) Conversion of mycelium to yeast phase growth at temperatures less than 37° C. of H. capsulatum in vitro was to be used as a criterion in the assay for some chemical component of the morphogenetic process extracted from S. cereviseae. Yeast cells (S. cereviseae) were subjected to a number of solvents and counter solvents from which several fractions were obtained. A substance which acted directly in the morphogenetic process was not demonstrable in any of the several fractions tested, and frank mycelial to yeast conversion did not occur at temperatures less than that of the mammalian body. Certain noticeable morphologic alterations were noted and extreme toxicity of certain portions of the yeast cell extracts were demonstrated.

It is concluded that dimorphism in pathogenic fungi is induced by environmental conditions imposed, of which mammalian body temperature is the most important, and that the pathway allowing, if not the directive mechanism itself, is intrinsic in the organism. Associated with this conversion to a yeast-like phase is the ability to invade deep tissues of homothermic animals.

Microfilm $2.50; Xerox $5.40. 108 pages.

A STUDY OF COXIELLA BURNETII IN CULTURED MAMMALIAN CELLS

(L. C. Card No. Mic 59-6948)

Audrey Nadine Roberts, Ph.D.
University of Kansas, 1959

Infection of the L strain mouse fibroblast with Coxiella burnetii occurred in not less than 30 min of contact at 35 C. A direct correlation between the penetration time and the numbers of organisms which succeeded in invading and infecting the host cells was demonstrated. The 8-hr to 24-hr contact cultures contained more heavily infected cells throughout the first 48 hr incubation than did the 30-min to 4-hr contact cultures; thus indicating that the longer penetration periods might allow not only more cells to become infected, but also the invasion of more rickettsiae per cell.

C. burnetii multiplied at a relatively slow rate in the L cell. A 3 log increase was demonstrated in the yolk sac LD_{50} over the first 72 hr incubation at 35 C. It was demonstrated that the rickettsiae were not capable of multiplying in cell-free Eagle's medium. The organisms did not die rapidly in this environment, however, the egg LD_{50} falling only 4 logs throughout 7 days of incubation. The greatest decrease in the number of infectious organisms was observed between the 0-hr culture and the 3-day samples. Also, the organism did not multiply in either L cell debris or heat-killed fibroblasts.

An incubation temperature of 35 C provided an optimal environment for this host-parasite system. No detectable rickettsial penetration or multiplication occurred at 5 C. Slower multiplication of the organisms in L cells occurred at 25 C and 40 C than at 35 C and 37 C.

C. burnetii was maintained through 20 transfers in the mouse fibroblasts. No significant decrease in the yolk sac infectivity of the passaged rickettsiae occurred throughout this study. Also, no increase in infectivity of the rickettsiae for the L cell was evident.

It was demonstrated that C. burnetii dies rapidly in L strain mouse fibroblasts which are maintained in simple protein-free media. Neither Eagle's vitamins nor Eagle's amino acids could be substituted for the protein. Although the simple media did not support L cell proliferation, the host cells survived very well throughout the 72-hr incubation period. Decisive variations were noted in the appearance of infected L cells maintained in protein-free media as compared to those in complete Eagle's medium. Infected fibroblasts maintained in only Hanks's balanced salt solution displayed almost complete cell destruction within the first 24 hr incubation at 35 C. Only degenerating cells and cell debris surrounded by small clumps of organisms were demonstrable in the stained coverslip cultures. This contrasted to those cells fed with serum-containing media, in which the organisms were isolated in characteristic vacuoles. However, more cytopathic effects were noted in those cells maintained in Hanks's BSS plus horse serum than in complete Eagle's medium. Further studies revealed that there were no significant differences in the rickettsial penetration and multiplication in host cells maintained horse serum-medium and calf serum-medium.

Since C. burnetii gave highly variable results in yolk sac titrations, the coverslip culture method of rickettsial titration was selected as the method of quantitation to be used for most of the studies which were made. Also, from quantitative comparisons of the coverslip culture method of rickettsial titration and the plaque technique, it was concluded that the latter was less accurate and sensitive. Such studies were made on the L cell-rickettsial system and the infected HeLa cells and Chang's liver cells. A comparison of the L cell, HeLa cell and Chang's liver cell as to sensitivity, accuracy and dependability in making titration studies of rickettsial suspensions demonstrated no substantial differences between the three cell lines.

The appearance of normal and infected L cells as observed with fluorescence microscopy is described. The infection was shown to be strictly intracytoplasmic. No organisms were seen in the nuclei of infected cells, but they were often observed in areas directly adjacent to the nuclei. No intracellular rickettsiae were visible prior

to 18 hr incubation. At this time, the rickettsiae were seen as minute pin-point fluorescing spots within the cytoplasm of approximately 2 per cent of the cells. Further studies using fluorescence microscopy were made. Also, comparisons were made between the Macchiavello's technique and the fluorescent antibody technique in their delicacy of detecting rickettsial infected cells. Microfilm $2.50; Xerox $8.00. 171 pages.

STUDIES ON THE INFECTIVITY AND TOXICITY OF MENINGOPNEUMONITIS VIRUS

(L. C. Card No. Mic 59-5584)

Kendall Owen Smith, Ph.D.
The University of North Carolina, 1959

Supervisor: Dr. George Philip Manire

A rapid method for estimating the meningopneumonitis virus concentration of crude and purified suspensions is described. A suspension of polystyrene particles of uniform size and known concentration is mixed with an equal volume of a virus suspension, the mixture smeared on a glass slide, fixed, stained, and examined by phase contrast microscopy. The number of particles of each type is counted in several areas, and the ratio of the particles determined. The concentration of virus is calculated from this ratio and the concentration of the standard polystyrene particle suspension. The advantages of using polystyrene particles as a standard are several. These particles are stable on storage, easily standardized by direct counting in a bacterial counting chamber, easily visualized by phase microscopy, and clearly differentiated from virus particles. The validity of the technique is supported by the close correlation between particle counts, egg infectivity, mouse toxicity, total nitrogen content, and dry weight determinations. The significance of physical, chemical, and biological data obtained in studies with this virus has been greatly increased by the availability of the particle counting technique.

The average number of crude allantoic fluid virus particles per egg lethal dose$_{50}$ was found to be approximately 150. The infectivity of crude yolk sac virus is much greater, averaging 13 particles per egg lethal dose$_{50}$. The toxicity of meningopneumonitis virus for 9-20 gram mice is related directly to their total body weight. The accurate estimation of toxic challenge virus dosage is important in studies on the toxin antigen. A simple, accurate method for calculating the number of virus particles per toxic lethal dose$_{50}$ for mice of any weight between these weight limits is presented. The following relationships have been determined: one gram total nitrogen of purified virus contains $10^{14.3}$ particles; one gram dry weight of purified virus contains $10^{13.4}$ particles; $10^{7.5}$ particles of crude yolk sac virus is equal to one toxic lethal dose$_{50}$ for 9 gram mice. In terms of purified virus, the toxicity of meningopneumonitis virus is 0.008 lethal dose$_{50}$ per ug dry weight of virus per Kg mouse body weight. The toxicities of Salmonella typhi and diphteria toxins are 0.0002 and 3.5, respectively.

The particle counting procedure was used to study the growth of meningopneumonitis virus in the chick embryo. The injection of large amounts of virus resulted in a marked reduction in virus production efficiency. There was also evidence that the injection of large inocula results in a decrease in total yields of virus. It was found that the age of the embryo was another factor influencing the total amount of virus produced before death. These observations, aside from being of theoretical interest, have proved useful in that the amount of virus obtained from a given number of embryos has been increased by a factor of 10-20.

All efforts to remove active toxin from intact virus particles have been unsuccessful. Further, it has been impossible to date to destroy the infectivity of a suspension of toxic virus without also destroying its toxicity. An attempt was made to isolate a serologically active toxin component by various fractionation methods. The toxin antigen was unstable under most conditions used by other workers to isolate psittacosis virus antigens. The most potent antigen preparations were obtained by differential centrifugation methods. Brief exposure to detergents appears to be useful in obtaining larger amounts of toxin antigen. Evidence is presented which indicates that the toxin antigen is associated with the virus membrane.
Microfilm $2.50; Xerox $6.80. 141 pages.

ATTEMPTS TO IDENTIFY THE VIRUS OF INFECTIOUS HEPATITIS USING TISSUE CULTURE TECHNIQUES

(L. C. Card No. Mic 59-6640)

Robert Edwin Stevenson, Ph.D.
The Ohio State University, 1954

At the present time, two disease entities, infectious hepatitis and serum hepatitis, have assumed the proportions of a major problem in the armed forces and various institutions.

These virus diseases are characterized by a syndrome of anorexia, malaise, fever, leukopenia, epigastric tenderness, liver damage, biliuria, and jaundice, but are differentiated by the length of incubation period and by the lack of cross immunity.

Attempts to transmit the viruses to animals, which included the inoculation of 20 species of primates as well as a host of birds and mammals, have been unsuccessful.[1] To date, human volunteers remain the only proved susceptible host for these viruses.

No specific serologic test has been developed for these agents. Investigations using complement fixation,[2,3] hemagglutination,[3] collodion particle agglutination,[4] and skin test techniques[5] have uncovered a variety of heterogenetic and autoantibodies which are apparently unassociated specifically with hepatitis viruses.

An endeavor by Henle and associates[6] to grow the virus of infectious hepatitis in tissue cultures of chick embryo and rabbit liver fibroblasts resulted in equivocal success which has not been confirmed. Failure to obtain virus proliferation in their experiments may have resulted from the possible requirement of a specific cell type and/or human cells for growth by infectious hepatitis virus.

Recent development of long-term cultures of human

cancer cells and liver cells from the mouse, and the possibility of growing hepatic cell cultures from human liver offered the basis for testing the following hypotheses:

1. The virus of infectious hepatitis might be able to grow in the functional liver cells of various animal species if humoral factors of immunity were removed, as is possible in tissue cultures.
2. The virus of infectious hepatitis might be able to grow in nonhepatic human tissue.
3. The virus of infectious hepatitis might be able to grow only in human liver cells.

It was felt that results of such investigations might eliminate the need for using human volunteers, might provide a source of virus for further study, and might reveal a basis for a diagnostic test for the presence of the virus.

Having come into possession of a collection of fecal and serum specimens from cases of infectious hepatitis obtained by the Ohio Department of Health, and in association with the physical facilities of the Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, the investigations outlined above were made feasible.

Experimental Procedures and Results

Extraction and concentration of fecal specimens from normal and infected individuals were made using differential centrifugation procedures, in order to obtain inocula for tissue cultures with minimum toxicity and increased viral activity.

In addition to short-term cultures of chick embryo liver cells, the HeLa strain of malignant human epithelial cells and Earle's mouse liver cell strain 1469 were used in replicate cultures as substrates for the inoculation and serial passage of fecal extracts in various dilutions. Results of these experiments showed degenerative changes and pH differences in some cultures inoculated with various normal and infected extract preparations.

Attempts to show a specific etiology for these changes were made by using tissue culture passage materials as antigens and serum from convalescent cases of infectious hepatitis as antibody in the complement fixation reaction. Results of these tests were negative. At the same time, uninoculated extracts were tested with the same sera. One extract derived from a normal stool and four extracts derived from infected stools fixed complement in the presence of convalescent sera.

Attempts to secure long-term and/or short-term cultures of human liver parenchymal cells for inoculation with extracts were made using tissue from premature infants. Various media and substrates were used in these experiments and were chosen on the basis of preliminary experiments with other animal tissues.

Cultivation of cells resembling those of human liver parenchyma was achieved and these were transferred successfully from the original culture. Contamination of the cultures by bacteria prevented the securing of an adequate amount of these cells for virus inoculation. Other human tissues were cultivated, but growth also was insufficient for virus inoculation.

Other studies, including hemagglutination tests, and the inoculation of fecal extracts and blood from hepatitis patients into suckling mice were conducted. Hemagglutination studies revealed the presence of a heterogenetic antibody in sera from a patient with infectious hepatitis. Hemagglutination of rabbit erythrocytes with fecal extracts from the same patient were not inhibited by immune sera, and hemagglutinating properties were also found with fecal extracts derived from normal individuals when tested in the same manner.

Discussion

Since human volunteers were unavailable for proving the presence of infectious hepatitis virus in the original materials, the fecal specimens used were selected on the basis of case histories and were collected at times when virus was expected to be present. These periods of virus excretion have been determined by human volunteer experiments.[7]

Failure to demonstrate specificity of the changes observed in inoculated tissue cultures may have been due to either too small an amount of virus present, or to an inability of virus-antibody complex to fix complement, or to a failure of the virus to proliferate. The pH differences observed in the culture media require further passage work before their significance can be ascertained. Positive complement fixation test with concentrated extracts were thought to be suggestive and were not comparable to the results obtained by Havens.[2]

Possible modifications of the experiments completed to date were suggested for future investigations, in order to determine whether virus proliferation had occurred.

The successful cultivation of human liver cells was thought to be due to the medium employed, which was devised on physiologic considerations. Concepts of cell cultivation were discussed in the light of these findings.

Results of the hemagglutination tests were compared with the findings of Eaton[3] and Havens[2] and were discussed.

Conclusions

From these experiments it may be concluded that:

1. Inoculation of extracts into tissue cultures of Earle's 1469 mouse liver strain and of the HeLa strain of human cancer tissue followed by serial passage revealed degenerative changes with some extracts when observed in the living state.
2. Fixation and staining of cells from inoculated cultures showing degeneration revealed no specific changes attributable to virus infection.
3. Examination of culture suspensions from serial passages failed to demonstrate fixation of complement with immune sera.
4. Fixation of complement with immune sera was noted in some fecal extracts prepared by ultracentrifugation.
5. Observation of pH differences between media of some inoculated cultures and media of control cultures requires further investigation.
6. Cultivation of tissue cells morphologically resembling human liver parenchymal cells was achieved, although not in quantity sufficient for virus inoculation.
7. Formulation of a medium for cultivation of human liver cells is proposed.
8. Hemagglutination tests with sera from patients with IH revealed a type of heterogenetic antibody.
9. Inoculation of suckling mice with whole blood and fecal extracts from patients with IH produced no evidence of infection. Microfilm $2.50; Xerox $5.40. 106 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

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Abstract published by special arrangement with The Ohio State University.

STUDIES ON THE MECHANISM OF ANAPHYLAXIS PRODUCED IN THE MOUSE WITH SOLUBLE ANTIGEN-ANTIBODY COMPLEXES

(L. C. Card No. Mic 59-5478)

Seikichi Tokuda, Ph.D.
University of Washington, 1959

Chairman: Russell S. Weiser, Ph.D.

Soluble antigen-antibody (Ag-Ab) complexes were prepared by adding heat-inactivated anti-bovine serum albumin (antiBSA) rabbit serum to excess BSA and also by dissolving the specific BSA-anti BSA precipitate in excess BSA. The intravenous injection of these complexes into normal non-sensitized Swiss white mice was followed by a series of reactions which are indistinguishable from anaphylaxis in mice sensitized and challenged with Ag in the usual manner. The susceptibility of normal mice to soluble Ag-Ab complexes can be enhanced by the prior administration of H. pertussis vaccine. Preliminary studies also indicated that Sarcoma I tumor-bearing Swiss mice are more susceptible to challenge with soluble Ag-Ab complex than are normal Swiss mice. Rate and guinea pigs were apparently more resistant to the challenge preparations of soluble complex used in this investigation than were normal mice.

The prior injection of a sub-lethal preparation of soluble complex conferred a state of non-specific refractoriness to subsequent challenges of lethal preparations of soluble complexes.

Soluble Ag-Ab complex preparations formed in the regions of extreme Ag excess (60x and 180x Ag excess) were markedly less anaphylactigenic than the preparations formed in regions of low to moderate Ag excess.

The inactive complex formed in the regions of extreme Ag excess have the theoretical molecular configuration of Ag_2Ab; the toxic complexes formed in the regions of low to moderate Ag excesses are larger and more complicated than Ag_2Ab. The hypothesis is advanced that the anaphylactigenic activity of these complexes is dependent upon their capacity to react with complement. Suggestive evidence is presented to indicate that large complexes derived from dissolved precipitates have higher bond strength and are not as readily reversed to simpler complexes in extreme Ag excess as are soluble complexes initially formed in the region of low Ag excess.

Evidence to implicate serotonin in the anaphylactic reaction of the mouse have been indicated by the following observations: (a) the antiserotonin agents LSD-25, Chlorpromazine and BOL-148 protected against fatal anaphylactic shock, (b) serotonin and the serotonin precursor 5-HTP enhanced anaphylaxis, and (c) the protective action of reserpine can be diminished by the prior administration of 5-HTP. However, it was observed that BOL-148 and reserpine failed to protect against anaphylaxis in pertussis-vaccinated mice challenged with soluble Ag-Ab complexes.

Various other pharmacological agents were tested and those that possessed anti-anaphylactic activity were: adrenaline, nor-adrenaline, dopamine, cortisone acetate, sodium salicylate and histamine. The anti-histamine agent, pyrilamine maleate, failed to protect against anaphylaxis.

Histological examinations of the mast cells from mice challenged with soluble Ag-Ab complex and from mice actively sensitized and challenged with Ag failed to establish that these cells undergo morphological alterations during the anaphylactic reaction.

Gross and histological examinations of the tissues and organs of mice shocked with lethal preparations of soluble complex revealed congestion but no hemorrhage. It is suggested that death due to challenge with soluble Ag-Ab complex may be attributed to a generalized circulatory collapse. Microfilm $2.50; Xerox $5.00. 100 pages.

THE PRODUCTION OF BRUCELLA AGGLUTININS IN VITRO BY LYMPH NODES FROM IMMUNIZED RABBITS

(L. C. Card No. Mic 59-4678)

Benjamin Wolf, Ph.D.
University of Pennsylvania, 1959

Supervisor: Israel Live

An in vitro system was utilized to investigate the production of agglutinins to Brucella abortus. Evidence was presented which indicated that synthesis of antibody occurred in vitro by lymph nodes removed from previously immunized rabbits.

Alum-precipitated, ether-killed Br. abortus was injected into the rear foot pads of rabbits on three successive

days of one week for the primary stimulation. Another injection was given three weeks later to elicit the booster response. After three days, the popliteal lymph nodes were removed and cut into small fragments. About 25 mg. of tissue was placed into 1 ml. of W medium[1] and cultivated for 24 hours. The fragments elaborated antibody into the medium during this time interval. The production of small quantities of agglutinins in vitro was measured by a modification of the Boyden hemagglutination technique,[2] for which a brucella extract, obtained by sonic oscillation was utilized.

It was found that the above procedure sufficed to stimulate antibody formation in vitro by explanted lymph node fragments. Rate studies showed that much of the antibody was formed in the first 24 hours, with some suggestion of antibody production in the 24-48 hour interval. Respiratory enzyme inhibitors, such as cyanide, azide, and 2, 4 dinitrophenol depressed antibody synthesis. Ethionine, an amino acid analogue, did likewise, as did three-fold concentrations of the amino acids in W medium.

Data have been presented which suggested that an active synthesis of antibody occurred in vitro. Respiratory enzyme depressants, such as cyanide, azide and dinitrophenol, which uncouple oxidative phosphorylation, and therefore protein synthesis, inhibited antibody formation. Ethionine, which interfered more specifically with protein synthesis, also inhibited antibody production. The addition of three-fold concentrations of W medium - amino acids suppressed antibody formation. Since the normal concentration of amino acids stimulated antibody production, inhibition by these higher concentrations of amino acids suggested interference with cellular metabolic processes or permeability effects.

Microfilm $2.50; Xerox $3.00. 45 pages.

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BIOLOGY — GENETICS

INHERITANCE STUDIES OF CERTAIN FRUIT AND PLANT CHARACTERS IN CAPSICUM FRUTESCENS

(L. C. Card No. Mic 59-5372)

Alvin Hugh Dempsey, Ph.D.
The Ohio State University, 1953

A genetic study was made which involved two varieties of red pepper (Capsicum frutescens L.). The purpose of the investigation was to determine the segregation and inheritance of plant height and stem diameter; fruit length, width, shape, and fruit wall thickness; pungency, fruit position, and resistance to bacterial spot, Xanthomonas vesicatoria (Doidge) Dows.

The parental lines were self-fertilized three times before controlled crosses were made. Santanka, an introduction from Japan, was used as the female parent. Santanka (P_1), which has small, erect, elongated, pungent fruits and is resistant to bacterial spot, was crossed with Truhart Perfection (P_2), which has conical, pendent, non-pungent fruits and is susceptible to bacterial spot. The F_2 seeds were obtained by selfing F_1 plants; some F_2 individuals were selfed in order to obtain the seeds for the F_3 families to be studied. Data were obtained from a sample of fifty plants for the parental lines and the F_1 generation. Observations were made on 504 individual plants in the F_2 generation. Nine F_3 families with approximately fifty plants each were used for the studies of fruit position, fruit pungency, and resistance to bacterial spot. Photographic evidence was presented to show the segregation of certain characters investigated.

A chemical test, with vanadium oxytrichloride in carbon tetrachloride as an indicator, was used to classify population samples of the parental lines and hybrid generations for fruit pungency.[1] Ting suggested that the fruit samples be ground in a mortar, but to increase efficiency the samples were ground by an intermediate Wiley mill for the work reported herein.

In the studies of plant height, a quantitative character, the F_1 and F_2 means were intermediate between the means for the heights of the parents. Results of comparing the F_2 generation with the expansion of the binomial $(a + b)^6$ favor the hypothesis that three pairs of polymeric genes were involved in the inheritance of plant height for this cross.

When the P_1 (17.3 mm.) was crossed with P_2 (26.7 mm.), the F_1 progenies were found to resemble the P_1 for stem diameter, showing dominance of the small parent. The F_2 mean was larger than the F_1 mean, which was expected with the dominance of P_1. The curve resulting from the plotting of the F_2 generation for stem diameter was very obviously bimodal. The segregating F_2 sample was divided into the two modal classes suggested by the curve and a test for goodness of fit with a 3:1 ratio gave a Chi square value of 0.68 with a probability of .50 to .30.

The first five mature fruits from each plant were harvested for the fruit length, width, and shape studies. Length was measured from the calyx edge to the distal end of the individual fruits, and width was determined at the midpoint of the length, to the nearest millimeter. A cross section was made at midpoint of the fruit and the fruit wall thickness measured to the nearest tenth millimeter with a vernier caliper. The shape indices were obtained by dividing length by width.

Transgressive segregation was reported for fruit length in some individuals in the F_2 that were smaller and in some that were larger than either parent. Regarding fruit width, some plants produced fruits as small as

Santanka, the small parent, but the large (P_2) was not recovered in the F_2 generation.

The trimodal nature of the curve for the distribution of the F_2 generation for fruit shape indices, when plotted logarithmically, revealed that fruit shape was controlled by one gene pair with incomplete dominance and multiplicative effects.

The distribution of the F_2 generation for fruit wall thickness was skewed and unimodal when plotted on an arithmetic scale, but when plotted in classes which were logarithmically equal, a more nearly symmetrical curve resulted. It was concluded that eight pairs of genes with multiplicative, cumulative effects were operating to determine fruit wall thickness in this material.

Pungency, pendent fruit position, small stem diameter, and susceptibility to Xanthomonas vesicatoria (Doidge) Dows. were inherited as monogenic, dominant characters.

Linkage was established from F_2 data between pungency and erect fruit position. Loose linkage was indicated by the high crossover value of 0.3443 + 0.0387.

Sample populations of the parents and the first, second, and third filial generations were observed for resistance to Xanthomonas vesicatoria (Doidge) Dows., which was artificially inoculated under controlled conditions in the greenhouse. Homozygous resistant lines were recovered in the third filial generation from plants that were phenotypically resistant in the second filial generation. It is of interest from a plant breeding view point to know that types resistant to bacterial spot organism were readily developed from crosses between susceptible and resistant peppers. Microfilm $2.50; Xerox $4.00. 74 pages.

1. Ting, S. V. and Barrons, Keith C. "A Chemical Test for Pungency in Peppers," Amer. Soc. Hort. Sci., 40 (1942), pp. 504-508.

Abstract published by special arrangement with The Ohio State University.

THE COMPARATIVE GENETICS OF GOSSYPIUM HIRSUTUM L. AND THE SYNTHETIC AMPHIPLOID, GOSSYPIUM ARBOREUM L. X GOSSYPIUM THURBERI TOD.

(L. C. Card No. Mic 59-6561)

Jose Alejandro Giles, Ph.D.
North Carolina State College, 1959

Supervisor: Stanley George Stephens

A synthetic amphiploid of the hybrid, G. arboreum x G. thurberi, was crossed to multiple dominant and recessive G. hirsutum marker stocks to compare genetically the two diploid species with the corresponding A and D sub-genomes of hirsutum.

Ten hirsutum mutants, characterized by their monofactorial segregations, were used in the test. The sub-genome location of six of them had been determined previously. The present studies provided evidence for the location of cup leaf, nectariless and virescent yellow in the A sub-genome of G. hirsutum.

The study was made to find out whether the two diploid species, arboreum and thurberi, carry dominant genes which would cover a given hirsutum mutant. Both diploid species were found to have dominant genes for five of the hirsutum mutants, whereas in the cases of cluster, crinkle and virescent yellow the related diploid species did not carry a dominant allele homologous to the mutant of hirsutum. The A genome from G. arboreum masks the cluster and crinkle mutants in the D sub-genome of G. hirsutum; the virescent yellow mutant in the A sub-genome is masked by a dominant factor of G. thurberi.

The hirsutum linkage group, leaf shape-crinkle-green lint, was analyzed after a segment of thurberi chromosome carrying the narrow leaf (L) gene was transferred into the corresponding hirsutum segment. It was observed that the crossover percentage between leaf shape and crinkle was reduced, presumably due to differences between the thurberi and the hirsutum chromosomes. As a secondary effect the percentage of recombination between crinkle and green lint became increased as compared to the crossover percentage in pure hirsutum stocks.

Microfilm $2.50; Xerox $3.60. 62 pages.

A THEORETICAL STUDY OF THE KINETIC PROPERTIES OF SEQUENTIAL ENZYME REACTIONS

(L. C. Card No. Mic 59-4631)

Joseph John Higgins, Ph.D.
University of Pennsylvania, 1959

Supervisor: Britton Chance

This thesis presents a theoretical study of the kinetics of general types of sequential chemical systems, particularly those associated with enzyme catalyses. As a prototype of the general systems, the Michaelis-Menten mechanism is studied in detail and relationships are derived for the dependence of the half times, maxima, and steady state properties on the rate constants and initial concentrations. The general systems are developed with particular emphasis on those features of the kinetics which can be used to distinguish the different intermediates and the different types of systems. In this regard, $t_{1/2}$ off ordering theorems, maximum ordering theorems and properties of overshoots are derived for the intermediates. Finally, a quantity called the "reflection coefficient" is developed for the study of steady state properties. The theoretical values of the reflection coefficients are easily obtained for irreversible systems and provide a convenient starting point for the derivation and discussion of many of the kinetic properties. In addition the reflection coefficients can be directly measured experimentally and provide a useful method for determining the mechanism.

The understanding of this thesis allows the experimenter to deduce the specific mechanism from the general types studied when the kinetics of all intermediates can be measured with an experimental accuracy of about two to five percent. Even when only a few of the intermediates can be detected, many of the theorems provide some information concerning the mechanism. In addition, the mathematical techniques and the use of the computer presented here can be extended to other types of chemical systems. Microfilm $3.65; Xerox $12.40. 282 pages.

ISOLATION AND CHARACTERIZATION OF ULTRA VIOLET IRRADIATION INDUCED MUTANT STRAINS OF CHLAMYDOMONAS REINHARDI

(L. C. Card No. Mic 59-4825)

John Thomas Newell II, Ph.D.
Northwestern University, 1959

Adviser: L. H. Tiffany

Wild type cultures of Chlamydomonas reinhardi were irradiated with ultra violet light to induce genetic mutation. Nutritional screening of the irradiated cells yielded 13 metabolically mutated strains. Nine of these strains were "Absolute" mutants, the remaining four were "Rate" mutants. Microscopic examination of irradiated cells yielded numerous morphological mutants. The most common morphological mutations were as follows: abnormal flagellar mechanisms, abnormal plastids, abnormal cell size, and unusual vacuoles. Optimum environmental conditions proved to be a light intensity of 800 foot candles and temperatures of 22 - 25°C. Strict environmental requirements, slow growth rates, ultra violet resistance, metabolic reversion, and low mutation rates indicated that while C. reinhardi is usable as a genetic tool, it is probably not the best choice for most work. It is possible that more satisfactory results could be obtained employing a different mutagen.

Microfilm $2.50; Xerox $3.60. 65 pages.

THE EFFECT OF SOME AUTOSOMAL INVERSIONS ON LETHAL MUTATION IN DROSOPHILA MELANOGASTER

(L. C. Card No. Mic 59-6726)

Peter Ervin Thompson, Ph.D.
The University of Texas, 1959

Supervisor: Burke H. Judd

The frequencies of lethal mutation in wild chromosomes paired with the multiple inversion chromosome SM1 and Ubx^{130}, and in identical wild chromosomes made homozygous, were determined. The rate of lethal mutation in inversion heterozygotes was significantly higher than in homozygous lines. The spontaneous lethals obtained from heterozygous lines were located by their linkage with dominant visible markers. The possibility of a clustering of lethals near points corresponding to loci of break points in the inverted chromosome was evaluated. Possible bases for mutational interaction between structurally dissimilar homologous chromosomes were discussed.

The frequencies and distributions of lethals from irradiated lines heterozygous for SM1 and UBx^{130}, and from homozygous normal lines, were established and compared. The lethal frequency in heterozygous irradiated lines was significantly higher than in homozygous irradiated lines. The distribution of autosomal lethals from the irradiated heterozygous source was similar to that obtained from heterozygous sources without external treatment, except for the absence of certain clusters. The bearing of this evidence on the process of lethal mutation in inversion heterozygotes was considered.

The allelism of lethals from heterozygous sources and their interaction with certain other mutants were determined and discussed.

Microfilm $2.50; Xerox $4.20. 80 pages.

BOTANY

SOME ASPECTS OF THE ECOLOGICAL LIFE HISTORY OF LINARIA DALMATICA

(L. C. Card No. Mic 59-5447)

Jack Franklin Alex, Ph.D.
State College of Washington, 1959

Supervisor: Dr. R. Daubenmire

Linaria dalmatica, a native of southeastern Europe, has become a serious weed in Spokane County, Washington. Taxonomy of this species was investigated and studies were conducted on factors influencing germination of seeds and seedling emergence, on growth and development of root and shoot systems, and on certain aspects of phenology during the first season of growth.

Descriptions of L. dalmatica and the segregated taxa, L. macedonica, L. grandiflora, L. dalmatica var. macedonica, and L. dalmatica var. grandiflora have been quoted from sixteen European and North American floras. Comparison of these descriptions with the wide morphological variation observed among twenty-four offspring of one maternal parent indicated that the segregated taxa may not be distinct from L. dalmatica. Apparently no type specimen of Linaria dalmatica (L.) Mill. is in existence.

Cyclic alternations of ten days stratification at 2°C and ten days drying at room temperature for two cycles induced a much higher percentage germination than did any other factor or combination of factors tested.

Meteorological data which preceded a flush of emergence from seed planted in fine sandy loam soil in a nursery indicated that the seeds may have been exposed to cyclic alternations of cold moist periods with warm dry periods.

Seedlings from which cotyledons and epicotyl were removed when only ten days old recovered by the development

of adventitious buds from the base of the hypocotyl and reached apparent maturity the same season.

The highest percentage emergence from seeds planted at different depths in five soil textures was from a depth of 1.27 cm in loamy sand. Emergence from seed planted on the surface occurred only in fine sandy loam. No seedlings emerged from seeds planted at various depths in either fine sand or coarse sand.

Roots of seedlings penetrated downward approximately 1 cm per day during the first 31 days in fine sandy loam. Thereafter the rate was slower but roots reached a depth of 56 cm after 105 days. The total length of all roots of one 105-day old plant grown in fine sandy loam exceeded 27,480 cm.

Adventitious stem buds were present on the primary axis after 22 days of age, and on the second and third order branch roots at 105 days of age. Stem buds on branch roots were mostly more than 16 cm distant from the primary axis and at depths of from 2 cm to more than 10 cm below the ground surface.

One or more adventitious branches usually arise from the crown of young plants and eventually become dominant over the primary axis, but exceptions were found in which no adventitious branches were produced.

During the first season of growth, stems may reach 80 cm in height (in 105 days). Older plants commonly exceeded 1 m and one was 205 cm tall.

Other than an apparent relationship between the initial flush of emergence and the environmental conditions which preceded it, and the first detached corolla which coincided with a heavy rainstorm, no other phase of phenologic development could be related to environmental conditions.

Some of the characteristics which contribute to the weedy nature of L. dalmatica are discussed and it is concluded that further studies on this species are required in order to formulate effective programs of control and eradication. Microfilm $2.50; Xerox $8.40. 183 pages.

A REVISION OF ERIOGONUM SECTION PEDUNCULATA

(L. C. Card No. Mic 59-5486)

Joe McCall Anderson, Jr., Ph.D.
University of Oklahoma, 1959

Major Professor: Dr. George J. Goodman

Eriogonum Subgenus Ganysma Wats. is described and the Section Pedunculata Benth. is redefined and revised taxonomically on the basis of the greater number of species now known, greater numbers of specimens available, and current concepts of taxonomy.

The revision is based on external morphologic features of the species as interpreted to indicate phylogeny. Characters utilized to segregate the subgenus, to define the section, and to unite the species series respectively are: leaf distribution and form; form of ramification in the inflorescence; pubescence; insertion and form of involucres; number and size of flowers; form, color, size, and pubescence of calyx lobes; and form of fruit.

The four subsections recognized and defined are Cernue, Reniformes, Inerma, and Trichopoda. Each is divided into species series under which the species are listed, described, and discussed as to typification, range, and interrelations as well as characters of differentiation. Bibliography and synonymy are cited after each accepted name to which they apply.

One new species and one new variety are proposed. New combinations are formed as required by the taxonomic interpretation.

Eriogonum Sect. Pedunculata contains forty-three species under which are accepted thirty-four varieties and two forms.

The geographic limits of the section are similar to those for the greater portion of the genus, being from western Texas and Mexico in Nuevo Leon northward to southern Wyoming, westward across southern Idaho to southwestern Oregon, southward to the northern half of Baja California and Sonora.

Microfilm $2.50; Xerox $4.40. 84 pages.

THE ROLE OF PHLORIDZIN AND OTHER PHENOLIC COMPOUNDS IN THE HOST-PARASITE PHYSIOLOGY OF THE APPLE SCAB DISEASE, INCITED BY VENTURIA INAEQUALIS (CKE.) WINT.

(L. C. Card No. Mic 59-6466)

Ervin Henry Barnes, Ph.D.
Purdue University, 1959

Major Professor: Edwin B. Williams

A chromatographic study was made of apple tissues infected with Venturia inaequalis, a fungus parasite which incites the apple scab disease. A fluorescent phenolic compound which increases in concentration in diseased tissues and a stimulatory principle from apple leaves which increases the growth of V. inaequalis were found.

The fluorescent phenolic compound was found to increase in concentration in the peel of fruits and leaves of several apple varieties infected with V. inaequalis. It is considered to be a normal product of the host since it occurs in trace quantities in healthy tissues; it increases in concentration in tissues infected with either V. inaequalis or Podosphaeria leucotrichia; and it was not found in filtrates of V. inaequalis cultures. It was concluded that the increase in concentration is a general response of apple tissues to the invasion of parasites. Chemical and physical properties of the compound are described.

The stimulatory principle has been identified as phloridzin. The metabolism of this compound to phloretin, phloroglucinol, p-hydroxyphenylpropionic acid, p-hyroxybenzoic acid and protocatechuic acid is hypothesized on the presence of phloretin and phloroglucinol in culture filtrates of V. inaequalis when it is grown in the presence of phloridzin. The only break-down product which stimulated the parasite was p-hydroxyphenylpropionic acid and it was concluded that utilization of this compound by V. inaequalis may be the basis for the stimulatory action of phloridzin, the parent molecule, on its growth.

The effect of these compounds and m-inositol on the growth and sporulation of V. inaequalis was studied.

Differences between the response of isolates representing three races of the parasite were examined to determine if they correlated with race differences. The response to m-inositol was the only difference which correlated with known genes for pathogenicity. The sporulation of isolates with the allele for avirulence on Geneva was inhibited, whereas it was not with those isolates with the allele for virulence.

The effect of these compounds on the expression of disease reactions was examined and it was found that all of the compounds induced resistant reactions in host selections (derivatives of R12740-7A, Russian) which are susceptible only to race 2 isolates but not in host selections (Geneva) which are susceptible only to race 3 isolates.

Preliminary studies on the effects of these compounds on the metabolism of the host indicated that new phenolic compounds are produced. The mechanism of action of the induction of resistance was discussed. The author concluded with the hypothesis that resistance is effected by the products of the host-parasite interactions and that the parasite is instrumental in the initiation of these reactions.

Microfilm $2.50; Xerox $3.60. 65 pages.

THE EFFECT OF THE OAK WILT FUNGUS UPON OAK WOOD

(L. C. Card No. Mic 59-6623)

William Henry Brandt, Ph.D.
The Ohio State University, 1954

This study was undertaken to attempt to ascertain the direct and indirect effects of the oak wilt fungus (Endoconidiophora fagacearum Bretz) upon oak wood, the direct effects being possible decay of the wood by the oak wilt fungus; the indirect effects, a possible oak wilt-induced acceleration of the decay caused by other organisms.

Small oak blocks were given a preliminary treatment with the oak wilt fungus or its metabolic products and then were decayed by fungi found to inhabit oak wilt-killed trees. Loss of static-bending strength was used as the criterion of the amount of decay.

The durability of wood from oak trees which had typical oak wilt symptoms was compared to the durability of wood from healthy oak trees, using increment borer samples according to methods developed by the Forest Products Laboratory at Madison, Wisconsin.

The oak wilt fungus displayed no capacity to decay oak wood or weaken it in any direct manner, even under conditions which permitted associated wood-rotting fungi to decrease the static-bending strength of oak by amounts ranging up to 90 per cent.

The rates of decay caused by fungi isolated from oak wilt-killed trees of black oak blocks upon which the oak wilt fungus had been growing were not significantly different (at the 5 per cent or 1 per cent level) from the rates of decay of blocks which had no contact with the oak wilt fungus.

The rates of decay of white, red, scarlet, and black oak blocks which had been soaked under reduced pressure in a filtrate from liquid cultures of the oak wilt fungus were not significantly greater at the 5 per cent or 1 per cent level than the rates of decay of similar blocks soaked in sterile liquid culture medium (potato extract).

The durability of increment borer samples of twenty-five red, black, and scarlet oak trees which had typical oak wilt symptoms was fully as good as similar samples from twenty-five comparable healthy trees. The average weight loss of the two groups differed by only 0.1 per cent.

The evidence obtained in the investigation indicates that the oak wilt fungus has no direct or indirect effect upon the rate of decay of oak trees infected by the oak wilt fungus. Microfilm $2.50; Xerox $3.00. 34 pages.

Abstract published by special arrangement with The Ohio State University.

REPRODUCTIVE BIOLOGY OF CALIFORNIA LILIES

(L. C. Card No. Mic 59-4413)

James Stanley Davis, Ph.D.
The Claremont Graduate School, 1958

The Swallowtail Butterfly (Papilio sp., Papilionidae) is the principal pollinator of L. humboldtii, L. pardalinum and L. kelleyanum. The Apollo (Parnassius sp., Parnassiidae) and Fritillary (Argynnis sp., Nymphalidae) Butterflies also pollinate these lilies to a lesser degree. Night-flying hawkmoths are the principal pollinators of L. washingtonianum and L. parryi.

Self-pollination experiments indicate almost complete self-incompatibility in 14 species of California lilies. The mechanisms responsible for this incompatibility were found to be: (1) poor germination of pollen, (2) slow or erratic behavior or the pollen tubes in the style, and (3) unfavorable physiological reactions in the ovary.

Scattering of pollen tubes of self-pollinated flowers at various levels in the style is the outstanding character of L. humboldtii. Failure of the pollen tubes to grow to the base of the style is the outstanding character in L. pardalinum. Slow germination of pollen plays a large role in the self-incompatibility of L. parryi and in certain individuals of L. washingtonianum. Unfavorable physiological reaction in the ovary must occur in L. parvum because the pollen tubes of self-pollinated flowers reach the ovary quickly, yet seeds are seldom formed.

Microfilm $2.50; Xerox $3.80. 66 pages.

VARIATION IN ANDROPOGON GERARDI VITMAN AND A. SCOPARIUS MX. IN TWO OHIO PRAIRIE AREAS

(L. C. Card No. Mic 59-5373)

Henry Rawie DeSelm, Ph.D.
The Ohio State University, 1953

The interpretation of relict vegetation in time and space is one of the most difficult problems in ecological plant geography. In Ohio, one of the most prominent and well-known communities is the prairie. The dissertation

is concerned with infraspecific variation in two dominant species of grasses, Andropogon gerardi Vitman and A. scoparius Mx., hereinafter referred to as Big and Little Bluestem respectively, from contrasting Ohio prairie areas. One sampling area is the Marion prairies on deep soils of glaciated north-central Ohio (Fig. 1); the other is the Adams county prairie area characterized by shallow soils in southern Ohio south of the Illinoian glacial border (Fig. 2).



Fig. 1.—View of a prairie remnant, northwest of Locust Grove, Adams county, Ohio. August, 1953.



Fig. 2.—A prairie remnant in southwestern Crawford county, Ohio. In the background is a grove of Quercus macrocarpa Mx. In front of it is an extensive Big Bluestem community. September, 1952.

Four methods have been used in this study. They are (1) determination of chromosome number and behavior, (2) comparison of results of grain germination in the two species from both areas, (3) measurement of stem elongation after growth was resumed by plants removed from the botanic garden to the greenhouse, and (4) morphological comparisons. In the last, population samples from both areas are compared with each other and with herbarium specimens collected on both sides of the glacial boundary in the prairie center. Comparisons are also made between sod transplants from both Ohio prairie areas which grew together in a common greenhouse environment.

The chromosomes numbers are those commonly reported for the species. They are 2n = 60 in Big Bluestem, and 2n = 40 in Little Bluestem. All chromosome pairs appeared to behave as diploids.

Results from the planting of over 20,000 spikelets reveal, generally, that in both species the real germination percentage is higher when grains are subjected to 10°C for from 30 to 50 days than when subjected to either more or less cold treatment. In Big Bluestem virtually no difference, according to source, in real germination percentage exists. Embryos of Little Bluestem from south of the glacial border germinate less well with cold treatment than those from the north of it. Also, in contrast to Big Bluestem, the other species exhibits a higher percentage of germination when planted in soil from the same prairie area as that from which the grain was collected.

Data from the measurement of stem elongation, which continued until flowering occurred, reveal that Big Bluestem from the south flowers at a slightly greater height than the same species from the north. Flowering occurred at about the same time. The two strains of Little Bluestem flowered at the same height, but those from the south flowered 28 days later than their northern counterpart. A differential temperature regime at the time of floral initiation may be responsible for the wide variance in the flowering date in this species.

Results from the measurement of many morphological characters in Big Bluestem reveal that in the Adams county populations

1. Stems are somewhat longer.
2. There are more nodes per plant.
3. There are a few more racemes per plant.
4. The rachis is usually shorter.
5. The longest trichome of the rachis is usually longer.
6. The pedicelled spikelet is slightly shorter.
7. The pedicel is somewhat shorter.
8. The longest trichome at the base of the second glume is somewhat longer.

In the Adams County Little Bluestem population,

1. The number of nodes per stem is greater.
2. There are generally fewer racemes per plant.
3. The number of fertile spikelets per terminal raceme is greater.
4. The longest trichomes at the base of the rachis and second glume are shorter.
5. The rachis and its longest trichome are usually shorter.
6. The sterile spikelet is usually shorter.
7. The pedicel is shorter although its glabrous base is longer.
8. The pedicel bearding is generally less dense.

9. The longest trichome of the pedicel is somewhat shorter.

10. The glumes are generally shorter.

These slight morphological differences between the two samples of Ohio Big and Little Bluestem suggest random variation in gene frequency.

Where comparisons are available between Big Bluestem from Ohio and material from the prairie center it is noted that in almost half the sets of measurements the Ohio prairie-center glaciated populations are more nearly alike than the unglaciated from both areas. In the rest, the two populations from south of the glacial boundary are more closely related than those to the north. This phenomenon suggests a closer relationship between the northern Ohio prairie-center plants and southern Ohio prairie-center plants than between the plants from north of the glacial boundary in Ohio and those from south of the prairie center and visa versa.

Data derived from measurements on Little Bluestem suggest a closer relationship between the Ohio prairie-center plants from north of the glacial boundary than between those from the same regions south of the boundary. This fact, when coupled with seeming ecotypic development of the Ohio Little Bluestem previously discussed, is suggestive of a greater "opportunity" for evolutionary divergence on the Ohio prairie area south of the glacial border. Whether the opportunity was in the form of "isolation" or due to the influx of new genetic material during a climatic shift is not evident. Such problems await further investigation.

Microfilm $2.50; Xerox $6.80. 141 pages.

Abstract published by special arrangement with The Ohio State University.

NATURAL HYBRIDIZATION IN SOME TROPICAL ORCHIDS IN THE ANDES

(L. C. Card No. Mic 59-4422)

Calaway Homer Dodson, Ph.D.
The Claremont Graduate School, 1959

A series of orchid populations belonging to different genera were studied in the Andes of Ecuador. In each case the population was extremely variable and in many cases there was direct evidence that hybridization was the cause of this variability.

1. Hybridization between Oncidium pusillum and O. pumilio in Central and South America has produced hybrid swarms as a result of disturbance of the habitat of O. pumilio by man. Oncidium pusillum grows in shady locations overhanging rivers and streams. O. pumilio grows on limbs at the tops of trees of Psidium guayaba exposed to direct sunlight. The pruning and cultivation of the trees provides an intermediate habitat suiting the requirements of hybrids between the two species. The hybrids have been named O. glossomystax and in certain areas populations of hybrids have become separately established and are relatively unvarying. Certain of these populations are morphologically dissimilar. A particular type of hybrid was found to be predominant in numbers and was found to be autogamous.

2. A variable population of Cranichis ciliata was found to result from introgression of genic material from C. cucullata as a result of disturbance of the habitat of the former species. Cranichis ciliata grows in dense shade under oak trees. C. cucullata grows in full sun in boggy meadows. The cutting of the oak trees and the consequent invasion by thorny scrub provides an ideal habitat for hybrids between the two species.

3. Epidendrum schomburgkii is predicted to be a species which results directly from hybridization between E. ibaguense or its local counterpart and E. nocturnum in extremely disturbed habitats provided by road building through jungles in western Ecuador.

4. An extremely variable population of Masdevallia aequatorialis, which is sympatric in distribution with plants of M. pusilla, is shown to be variable as a result of other factors than hybridization. Attempts to find correlation of varying characters were unsuccessful.

5. Populations of Oncidium nubigenum and its subspecies were studied and their extreme variability demonstrated. It is not known if hybridization is the prime factor involved in their variation.

The numerous forms found in the Orchidaceae are a result of rapid evolution. One evidence of rapid evolution is the degree of taxonomic difficulty encountered within a plant group and the Orchidaceae is notorious for its proportion of taxonomically difficult groups. In order for bursts of evolution to occur there must be considerable variability in adaptive systems and morphological forms within populations. These are to be found in abundance particularly in the tropical orchids. Variability can be a result of different factors, genetic and environmental. Hybridization is probably a very important source of variability in an epiphytic habitat. This type of habitat constantly provides new space for invasion of sexually produced generations. Hybridization is concluded to have played an extensive role in the evolution of the tropical American Orchidaceae under the ecological conditions of an epiphytic existence.

Microfilm $2.50; Xerox $6.60. 139 pages.

A CYTOTAXONOMIC STUDY OF THE GENUS COLOGANIA AND ITS RELATIONSHIP TO AMPHICARPAEA (LEGUMINOSAE-PAPILIONOIDEAE)

(L. C. Card No. Mic 59-6703)

Olin Stafford Fearing, Ph.D.
The University of Texas, 1959

Supervisor: B. L. Turner

This investigation presents a taxonomic treatment of the genus Cologania and in addition clarifies its relationship to Amphicarpaea, a genus with which Cologania has been associated. The study is a synthetic one using information available from classical herbarium study, populational analysis, geographical distribution, cytology and comparative morphology of pollen.

Cologania is a genus which shows, at the species level, a great degree of morphological variability as well as marked intergradation of morphological characters. It is proposed, in the present treatment, that this is the result

of two processes: 1) hybridity and/or out-crossing which produces a large reservoir of variability, and 2) cleistogamy, which functions to stabilize certain portions of the resulting genetic and morphological variation. These two processes have resulted in the formation of numerous small, local, more or less homogenous populations. The recognition of these populations has been responsible for the formation of a large number of species names by various authorities in the past.

Chromosomal information for the subtribe Glycineae has been reviewed. Chromosome counts of this subtribe can be arranged according to base chromosome numbers in the following three groups: 1) Clitoria, the only genus with a base chromosome number of x = 8, 2) Amphicarpaea, Centrosema and Glycine, genera with a base number of x = 10, and 3) Cologania, Dumasia, Eriosema, Kennedya and Periandra, the largest group of the subtribe, with a base number of x = 11. Chromosome numbers of Cologania, as determined from numerous counts on 3 taxa, were found to be 2n = 44 or n = 22. In addition to those of Cologania, chromosome counts of Dumasia and Periandra are reported in this dissertation for the first time.

The morphological characters of Amphicarpaea and Cologania have been critically compared. Morphological criteria, in addition to cytological information, pollen analysis and distribution patterns, indicates that Amphicarpaea and Cologania are best treated as distinct genera.

In a few select cases, populational studies have been used to indicate species limits as well as to demonstrate hybridity and resulting intergradation of morphological characters. Problems in need of further populational studies have been indicated where appropriate.

Ten species and two varieties of Cologania are treated in this dissertation. Species descriptions, synonymy, excluded taxa, plates to aid in species identification in addition to an artificial key to species are included.

Microfilm $2.50; Xerox $6.60. 140 pages.

DEVELOPMENTAL VEGATATIVE MORPHOLOGY OF AVENA SATIVA

(L. C. Card No. Mic 59-5669)

Gilford John Ikenberry, Jr., Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dr. John E. Sass

This study was undertaken to provide more complete information on the structure and development of the post-dormant vegetative phase of Avena sativa L.

The varieties Cherokee, Clintland, and Marion were used. Plants used to study stages prior to emergence from the soil were grown at 20°C. All post-emergent stages were obtained from field-grown plants.

Twelve hours after imbibition, the radicle has penetrated the pericarp. Mitotic divisions occur by 24 hours in the radicle, and by 27 hours figures are abundant in the radicle, seminal roots, coleoptile node, and first foliage leaf. Complete mitotic reactivation takes place by 36 hours.

Each leaf is initiated by a periclinal division in the tunica. Both the tunica and the corpus contribute to the leaf primordium after the initiating divisions. The third foliage leaf is initiated within 45 hours. Nine foliage leaves are initiated before transition to the floral phase occurs, 10 days after emergence from the soil.

Procambium strands are first evident at the level of the first or second leaf primordium below the apex. Strands increase in diameter at first by random division, than by tangential divisions which give rise to a cambiform zone of derivatives near the center of the strand.

Protophloem is first evident on the outer side of the procambium and consists of sieve tubes only. The first protoxylem element is evident after 2 or 3 protophloem cells are mature. The protoxylem consists of annular, spiral, and spiral-reticulate vessels. The protophloem and protoxylem are destroyed during the differentiation of the metaphloem and metaxylem.

The metaphloem consists of sieve tubes and companion cells. The metaxylem is composed of 2 large pitted vessels, and tracheary elements with circular or reticulate lateral pitting and with simple or reticulate end plates. The bundle sheath is derived from the procambium.

An axillary bud is initiated by periclinal divisions in the corpus in the axil of the second leaf below the stem apex. The tunica of a bud is derived from the tunica of the main axis. Buds arise acropetally in the axils of the first 4 or 5 foliage leaves at intervals of 2 to 4 days. All buds undergo floral transition.

The first 5 internodes are anatomically transitional between stem and root. Lodging resistance is associated with larger culm diameter, larger pith cavity, thicker hypodermis, and greater number of peripheral vascular bundles. However, under the conditions of this study the root system was a greater factor in lodging than straw strength. Microfilm $2.50; Xerox $3.00. 74 pages.

A STUDY OF THE BREEDING BARRIER BETWEEN GILIA AUSTRALIS AND GILIA SPLENDENS

(L. C. Card No. Mic 59-4426)

Howard Leroy Latimer, Ph.D.
The Claremont Graduate School, 1959

The taxonomy of two species of Woodland Gilia, G. splendens and G. australis, is reviewed and a new subspecies of G. australis is described.

The general crossability relationships of the two species were explored. The sympatric desert races were found to cross readily while allopatric populations crossed only with great difficulty. In all cases the cross is easily made only if australis is used as the female parent.

The embryology of several hybrid combinations between australis and splendens was studied. Hybrid seed failure was shown to be due principally to failure of fertilization and abnormal development of the endosperm. Failure of fertilization when the long-styled splendens was the female parent was apparently due to an insufficient number of pollen tubes reaching the ovary, whereas, when the short-styled australis was the female parent, fertilization often failed to occur even though the pollen tube entered the embryo sac. When fertilization did occur

with australis as female parent, the endosperm often failed to become cellular or disintegrated soon after becoming cellular. This abnormality was much more severe when the hybrid seeds resulted from crosses between allopatric rather than sympatric populations. When splendens was used as the female parent, the endosperm became prematurely mature. The exact nature of the almost complete seed failure when splendens is used as the female parent will not be understood until more data are obtained.

The few hybrids that have been obtained in crosses between allopatric races of australis and splendens have always been vigorous and semi-fertile. Combinations of the sympatric desert races, however, yield hybrids some of which are vigorous and some of which are semi-lethal dwarfs. The semi-lethality is explained by the interaction in the hybrid of a gene 1s from splendens and a gene 1a from australis. It has not yet been possible to determine whether the genes are independent and complementary, linked and complementary, pseudoallelic, or allelic, though crosses calculated to distinguish between these possibilities are in progress. Different degrees of lethality are observed when different strains are crossed. This is probably due either to modifier genes or to different alleles of the semi-lethal genes. The semi-lethal genes were present in all the desert populations of australis and splendens tested, although they were much more common in some than in others.

The hypothesis that reproductive isolating mechanisms may be selected for directly is analyzed. It is pointed out that this hypothesis is difficult to apply to isolating mechanisms effective in the F_1 or later generations, particularly in plants. On the basis of this and several other considerations, it is concluded that this hypothesis cannot explain the observed semi-lethal mechanism in Gilia splendens and G. australis or several similar cases in other plant groups. Several other possible explanations of the origin and present distribution of the semi-lethal mechanism are also considered, but none of the hypotheses are completely satisfactory, and the origin of the lethal genes remains problematical. Microfilm $2.50; Xerox $5.60. 113 pages.

DEVELOPMENTAL VEGETATIVE MORPHOLOGY OF GLYCINE MAX

(L. C. Card No. Mic 59-5674)

Jerome Phillip Miksche, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dr. John E. Sass

A study of the developmental anatomy of Glycine max, (L.) Merr., Var. Hawkeye was made; beginning with the status of organogeny and tissue organization of the dormant seed, through the post-dormant and emerging seedling, and subsequent development to floral initiation. The dormant cotyledons have netted venation. The large veins and some smaller veins have immature protoxylem, metaxylem initials, and mature protophloem. The mesophyll arrangement is leaf-like. A "pit" or depression, which is centrally located on the lower surface of the cotyledon, possesses epidermal cells which are plasmolyzed and hypertrophied at dormancy.

The oblique stem apex consists of a uniseriate tunica and a massive corpus at dormancy. The primordium of a trifoliate leaf had been initiated prior to dormancy, as evidenced by periclinal divisions of the outer corpus.

The structure of the dormant cotyledonary axillary bud is the same as that of the dormant main stem apex.

The general pattern of mitotic reactivation in soybean begins in the cortex of the root as evidenced by mitotic figures some distance away from the apical generating zone. Figures occur subsequently deep within the corpus of the stem apex and of the cotyledonary axillary bud, and still later in the root, and shoot apices.

Increasing necrosis of the cells of the surface pit of the cotyledon is evident. By the fourteenth day degeneration of the cells and external discoloration of the cotyledons are evident.

The first plastochron occurs approximately 80 hours after the beginning of germination, the second by 130 hours, forming the second and third trifoliate leaf, respectively. Each subsequent leaf is initiated at two day intervals. Floral initiation is microscopically evident in the axillary shoot of the first trifoliate leaf, approximately 20 to 24 days after planting. At dormancy, the vascular system consists of a procambium ring, with an enlarged strand to each unifoliate leaf. At 36 to 48 hours divisions in the procambium are at first in random planes, but a tendency to tangentially oriented divisions is definitely evident by 48 hours. This very precocious tangential activity may be designated as fascicular cambium. Interfascicular cambial activity is initiated in the internode above the cotyledons approximately five to six days after germination, and the complete ring of cambium is active by 20 days.

A starch sheath is derived from the innermost cortical layer, and is evident by nine days. The sclerenchyma cells that had been known for many years as "bundle cap" of pericyclic derivation, are formed within the region of the protophloem and are ontogenetically phloem fibers.

Microfilm $2.50; Xerox $3.80. 66 pages.

THE VASCULAR FLORA OF HIGH MOUNTAIN COMMUNITIES OF THE SOUTHERN APPALACHIANS

(L. C. Card No. Mic 59-5576)

George Shuford Ramseur, Ph.D.
The University of North Carolina, 1959

Supervisor: A. E. Radford

The spruce-fir forest of the higher peaks and ridges of the Southern Appalachian Mountains is similar in growth form to the northern conifer forest which is centered in southeastern Canada. This southern extension is unique in that Fraser's fir, Abies fraseri, takes the place of balsam fir, Abies balsamea, as the species co-dominant with Picea rubens. The isolation, the antiquity, and the possibility of geographical relationships to the northern conifer forest suggested that a study of the southern spruce-fir forest region would be worthwhile.

The objectives of this study were: to make a taxonomic study of the entire southern spruce-fir region; to

compare the flora of the various isolated areas; to study the stages of succession leading to the climax spruce-fir forest; and to study the geographical ranges of the dominant species.

The isolated high mountain areas of the Southern Appalachians were studied. Nested quadrats were plotted and analysed in the different plant communities. A total of 3708 specimens of vascular plants representing 392 species and varieties was collected.

The southern high mountain plant communities described are spruce-fir forest, fire cherry, grass bald, heath bald, shrub bald, beech forest, disclimax, and transition zone. The fire cherry community, the secondary succession community, is represented by the following forms: early fire cherry, fire cherry-blackberry, fire cherry-heath, heath-weed, fire cherry-weed, and fire cherry-yellow birch. The vegetation is dominated by the spruce-fir and fire cherry communities which are found in seven of the ten high mountain areas.

Seven geographical elements present in the southern high mountain flora are described as follows: Southern Appalachian species; Appalachian species; northern species extending southward in the uplands or mountains; northern species of general range near their southern limit; species of general range in eastern North America; and introduced species.

A summary of the taxonomic treatment of Abies in eastern North America is included in this study.

Range extensions are reported for Glyceria nubigena, Agrostis borealis, and Carex wiegandii. Rhododendron X wellesleyanum is reported for the first time in a natural stand. Microfilm $2.50; Xerox $5.40. 110 pages.

THE RELATIONSHIP OF GROWTH, PECTOLYTIC, AND CELLULYTIC ACTIVITY TO PATHOGENIC VARIATION AMONG ISOLATES OF COLLETOTRICHUM PHOMOIDES AND RELATED FRUIT ROTTING FUNGI.

(L. C. Card No. Mic 59-6612)

August Fredrick Schmitthenner, Ph.D.
The Ohio State University, 1953

As a part of a program initiated at the Department of Botany and Plant Pathology of The Ohio State University to investigate the nature of susceptibility, the pathogenic variation among a group of isolates of Colletotrichum phomoides (Sacc.) Chester, the tomato anthracnose pathogen, Colletotrichum lagenarium (Pass.) Ellis and Halst., the cucurbit anthracnose pathogen, and Glomerella cingulata (Stonem.) Spauld. and Schrenck, the bitter rot of apple pathogen, has been correlated with specific physiological differences existing among these isolates to determine some of the factors upon which parasitism and pathogenicity are based.

Twenty isolates, originally obtained from a variety of sources (apple, tomato, egg plant, pumpkin, muskmelon, watermelon, another isolate) were selected because of their apparent stability. The pathogenicities of these isolates were determined using fruits from 23 Plant Introduction tomatoes; 8 were chosen as representative of the range in pathogenicity. The rate of rot spread, colonization, was used as the criterion of pathogenicity. Of the 8 isolates, 2, C. lagenarium, were least pathogenic, 2, G. cingulata, were moderately virulent, and 4, C. phomoides, were most pathogenic.

Linear growth of these 8 isolates was compared on agars incorporating pressure-extracted, Seitz-sterilized juice from fruits of 7 of the Plant Introduction tomato types. The pectolytic activities of the 8 isolates were compared by determining the number of days for complete hydrolysis of a known quantity of pectin in liquid pectin-nitrate cultures. Cellulytic activities of the 8 isolates were compared by measuring the 10-day radius of the cellulose-free zone in reprecipitated cellulose-nitrate agar cultures with and without yeast extract. Cellulytic and pectolytic activities of 3 of the isolates, 1 C. lagenarium, 1 G. cingulata, and 1 C. phomoides, were tested also by determining the daily increase in reducing power in glycerol-pectin-nitrate and glycerol-cellulose-nitrate liquid cultures of these isolates.

Differences in pathogenicity, tomato agar growth, pectolytic and cellulytic activity between representative isolates of C. phomoides, C. lagenarium, and G. cingulata, using 3 of the plant introduction tomato types are summarized in Table I. A rating is given for each characteristic, with '0' representing the lowest expression of any characteristic (incapable of colonization, growth less than one-quarter that on potato-dextrose agar, and slow or incomplete pectolytic and cellulytic activity), 'x' representing a moderate expression of a characteristic, and 'x x' representing a high expression of a characteristic.

Table I. Relative tomato fruit colonization, growth rates, and pectolytic and cellulytic activities of representative isolates of C. phomoides, C. lagenarium, and G. cingulata

Characteristic	Representative Isolate of		
	C. lagenarium	G. cingulata	C. phomoides
Rate of Colonization			
Tomato A	0[a]	0	x x
Tomato B	x	x x	0
Tomato C	x	x x	x x
Growth (compared to PDA)			
Tomato agar A	x	0	x
Tomato agar B	x x	x x	x x
Tomato agar C	x x	x x	x x
Pectolytic activity	x	x x	x x
Cellulytic activity	0	x x	x x

[a] 0 - non-colonizing or slight activity or slow growth
x - moderate rate of colonization or activity or growth
x x - rapid rate of colonization or activity or growth

The rate of growth of the C. lagenarium isolate was considerably less than the rates of growth of the C. phomoides and G. cingulata isolates. The C. lagenarium isolate was not very virulent even when it did colonize tomato fruits. The low virulence of this isolate in

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tomato fruits may be due in part to its inherent slow growth rate.

The growth of the C. lagenarium isolate on the tomato agars was moderate to good as compared with its growth on PDA, and was not correlated with its ability to colonize tomato fruits. However, its pectolytic activity was poor, and the cellulytic activity was negligible in cultures containing inorganic salts and nonamino carbon source. Thus, the low virulence of the C. lagenarium isolate may also be explained on the basis of slow pectolytic and cellulytic activity.

The G. cingulata isolate, on the other hand, was pectolytically and cellulytically very active, but unable to colonize fruits of tomato A. Nonpathogenicity of this isolate can be correlated with poor growth of the isolate on agar incorporating juice of tomato A. Toxicity seems to be involved. The G. cingulata isolate apparently was more sensitive to this toxic effect than were the other isolates, though they also did not grow as well in agar incorporating the juice of tomato A as in PDA.

The C. phomoides isolate was pectolytically active and cellulytically active, and grew moderately to very well in all the tomato agars. This isolate did not colonize fruits of tomato B however. Apparently there are other factors involved in pathogenicity in this case. It is possible, in this instance, that the production of the pectolytic and cellulytic enzymes by the fungus is inhibited when the fungus is in the tomato.

One C. phomoides isolate was only slightly active pectolytically and another was not cellulytically active though both were quite pathogenic. Evidence was obtained with certain isolates that enzymatic activity is subject to extreme variation depending on the nature of the medium. Such variation may account for any lack of correlation between colonization rates and pectolytic and cellulytic activities of certain isolates.

Microfilm $2.50; Xerox $3.00. 45 pages.

Abstract published by special arrangement with The Ohio State University.

BIOASSAY OF THE SYSTEMIC ACTIVITY OF CYCLOHEXIMIDE SEMICARBAZONE IN CUCUMBER PLANTS

(L. C. Card No. Mic 59-5873)

Jan Rutger van Diepen, Ph.D.
The Ohio State University, 1959

A bioassay method, in which the assay medium consisted of a cucumber extract (from antibiotic-treated plants) supplemented with Bacto-agar and dextrose, was employed to study the systemic activity of cycloheximide semicarbazone in cucumber plants. The fungus, Pythium ultimum Trow, was found to be extremely sensitive to low concentrations of the antibiotic in vitro and was selected from several fungi as the most suitable biological indicator. This investigation, on the basis of the bioassay, has provided direct evidence that cycloheximide semicarbazone enters and is found in different concentrations in various parts of treated cucumber plants. Regardless of the method of application, whether by root immersion or by leaf immersion, the highest concentration of cycloheximide semicarbazone was present in the stem and leaves, the next highest concentration in the roots, and the lowest concentration in the hypocotyls. When cycloheximide semicarbazone was applied to cucumber roots there was a progressive increase of the chemical in the plants over a period of time. In addition, in the stem and leaves there was an accumulation of the chemical to a level above that provided to the roots. Stem and leaf extracts from cucumber plants had a greater inhibitory effect on the activity of cycloheximide semicarbazone in vitro than either extracts from roots or hypocotyls. The latter had the least effect.

Microfilm $2.50; Xerox $3.00. 40 pages.

FACTORS AFFECTING THE PATHOGENICITY OF COLLETOTRICHUM LAGENARIUM (PASS.) ELL. & HALST.

(L. C. Card No. Mic 59-6646)

Lansing Earl Williams, Ph.D.
The Ohio State University, 1954

INTRODUCTION

A fundamental prerequisite to an understanding of the physiology of parasitism and the nature of susceptibility is knowledge concerning the interactions of host and pathogen at the site of inoculation and invasion. Micro-environmental factors, at this place, which are subject to influence by metabolites of host and pathogen are important in subsequent disease development. The effects of such factors as temperature and humidity, measured only in the macro-environment, have been investigated extensively, but their effects have been expressed in terms of the end product, severity of disease. The mode of action has usually been a matter of conjecture, and possible effects on metabolites of host and pathogen at the inoculation site are obscured. Such metabolites, through their influence on spore germination, germ tube growth, appressorium formation, and invasion, may be the means by which macro-environmental factors affect disease development.

The present research includes studies of the influence of certain factors on the pathogen Colletotrichum lagenarium (Pass.) Ell. & Halst., and on the host plant, cucumber. The factors were leaf diffusates, conidial matrix, hydrogen-ion concentration, guttation, etiolation, and conidial source. Conidial germination, appressorium formation, and lesion development were used in measuring the importance of these factors in disease cycles.

MATERIALS AND METHODS

The isolate of C. lagenarium was a high sporulating strain which originated as a mass transfer from a sector of a single-conidial isolate from a diseased muskmelon leaf. Conidia used in germination tests were from cultures growing on agar slants containing approximately 20 ml. of a basal dextrose-nitrate agar medium. The conidia were removed with a wire loop from cultures approximately 19 days old. Washed conidia were obtained by centrifuging them through three changes of distilled water.

The suspensions were adjusted to approximately 100,000 conidia per ml. To known volumes of such suspensions were added equal volumes of various test substances. Counts were made in a Spencer Bright Line Haemocytometer. Four drops of the conidial suspensions were placed on glass slides coated with 1 per cent cellulose nitrate in butyl acetate. These slides were placed on a glass rod support in moist chambers which were sealed with water and maintained at 20°C. for 20-24 hours, as in the method of McCallan et al.[1] Twenty-five conidia were counted in each drop. Presence of a germ tube or appresorium was the criterion of germination.

Measurements of pH were made with a Beckman model H2 pH meter. When pH was standardized, HCl and NaOH were used. Buffer systems used were those of Sorenson and Clark, prepared according to Gortner.[2]

Plants of the cucumber variety Green Prolific were used in all foliage tests. Except in designated tests, the cucumber plants were inoculated as soon as the first true leaf neared maximum expansion. The conidial suspensions used as inoculum contained approximately 60,000 conidia per ml. Replicate plants were inoculated simultaneously in a spray booth equipped with a turntable, according to the method of McCallan et al.[3] The conidial suspensions were applied at 20 lbs. air pressure using a DeVilbiss No. 152 atomizer at the rate of 20 ml. per series of pots.

Immediately after inoculation the plants were placed in a moist chamber at a temperature of 20-21°C. and a relative humidity at or near 100 per cent. In the guttation experiments the chamber remained at room temperature, and high humidity was maintained by wetting-down the walls of the chamber rather than by using the mist apparatus.

To study the effect of guttation fluid on lesion development, the amount of the fluid reaching central areas of leaves was stopped or reduced in amount by the application of a petrolatum barrier around and over the margins of leaves.

Appressorium formation was studied by placing conidial suspensions in contact with substrates of different hardness. The substrates used in those experiments were cellulose nitrate coated slides, silicone coated slides, plastic covered slides, and plastic over a 2 per cent agar medium. The plastic used was a vinylidene chloride plastic sold under the trade name Saran Wrap by the Dow Chemical Company.

EXPERIMENTAL RESULTS

The germination of washed and unwashed conidia was compared. When the matrix which accompanied them was not removed, the percentage of germination in a suspension of 50,000 conidia was much higher than in a similar suspension of washed conidia. This was true of conidia suspended in distilled water, 0.01 per cent orange juice, leaf washings, and guttation fluid from cucumber plants. The germination of washed conidia was inhibited when they were suspended in high concentrations of matrix, but germination was promoted when the matrix was diluted sufficiently. Matrix removed from a known number of conidia inhibited the germination of the same number of washed conidia. The germination of unwashed conidia suspended in distilled water was inhibited by the accompanying matrix, as compared to washed controls, until diluted to approximately 360,000 conidia per ml., which corresponds to a dilution of 1 part conidia to 19,600 parts of distilled water. Greater dilutions resulted in the promotion of conidial germination. Matrix removed from the conidia of C. lagenarium also affected the germination of Monilinia fructicola, but in a different manner.

The germination of conidia of C. lagenarium is promoted also by diffusates from the leaves of cucumber plants, as evidenced by the increased germination of conidia suspended in distilled water washings from leaves of these plants. The percentage germination of conidia may be increased or decreased when suspended in guttation fluid from cucumber plants, depending upon the concentration of the fluid and the "germinability" of the conidia.

The initial pH of unbuffered 2 per cent glucose-conidial suspensions, placed as drops on glass slides, changes materially within a matter of a few minutes. Over a 24 hour period only the extremes of pH remained fairly constant, with many of the values within the middle part of the range drifting to practically the same end value. The change of pH due to the metabolic activity of the germinating conidia was slight in comparison with unknown influences which could not be attributed to activities of microörganisms. The change of pH caused by the germinating conidia is not in any one direction, but is influenced by the initial pH of the surrounding medium.

In previous work[4] the writer had determined that the optimum initial pH for the germination of conidia of C. lagenarium suspended in 2 per cent glucose solutions was at 3.5, with a second peak at 11.5. This was also substantiated during the present work. Conidia did not germinate in sodium borate (pH 2.0 to 12.0) or phthalate-buffered (pH 2.0 to 7.5) glucose solutions. Germination of conidia did occur, but at a very low percentage, under acid conditions on sodium citrate-buffered glucose solutions. Evidently this buffer is more toxic under alkaline conditions. The optimum pH for conidial germination in sodium citrate-buffered glucose solutions was essentially the same as that observed for conidia suspended in unbuffered glucose solutions.

The addition of distilled water washings of cucumber leaves to conidial suspensions greatly increased the percentage germination over a wide range of pH values. A low percentage germination was observed in the phthalate buffer when leaf washings were added; added to the sodium citrate buffer conidial germination was not only increased in the acid ranges, but germination occurred in the alkaline ranges. Percentage germination of conidia suspended in unbuffered leaf washings was greatly increased across the middle portion of the pH range, as compared to germination in unbuffered 2 per cent glucose solutions.

The initial pH of conidial suspensions had little or no effect on appressorium formation over a 24 hour period when the conidia were in contact with thin, hard substrates. More germ tube formation was observed with conidia in contact with softer substrates, the percentage being influenced by the initial pH of the suspension. At pH 3.0 and 3.5 almost all of the conidia formed appressoria regardless of the type of substrate. The percentage of appressorium formation of washed and unwashed conidia did not differ significantly.

In addition to the evidence that the matrix accompanying 60,000 conidia per ml. would promote conidial germination, data were obtained that the same amount of matrix would promote lesion development. A greater number of leaf lesions did appear on undipped cucumber plants when unwashed conidia were used as the source of inoculum.

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The changes of pH of conidial suspensions placed as drops on cucumber leaves were similar to the changes in the 2 per cent glucose-conidial suspensions placed on glass slides. The change of pH of the drops over a 24 hour period, as compared to that over a 15 minute period, was slightly greater at some of the pH values used. No significant differences were found between the pH of the drops placed on leaves of plants kept in the humidity chamber for 24 hours and drops placed on leaves of plants kept in the greenhouse.

The number of leaf lesions developing on cucumber plants from the application of unbuffered conidial suspensions was not correlated with conidial germination on glass slides. The greatest number of leaf lesions developed from suspensions within the pH range of poor conidial germination on glass slides (pH 6.0 and 7.5). Suspensions applied at pH 3.5, the most favorable pH in germination tests, caused only a few lesions. The greatest number of leaf lesions also appeared at pH of 6.0 and 7.5 when sodium citrate-buffered conidial suspensions were used; this was also a range of poor germination on glass slides. In contrast to the lesion development data obtained with unbuffered suspensions, however, good lesion development occurred when the conidial suspension was buffered at pH 3.0 and 4.0 with the sodium citrate buffer system.

The age of cucumber leaves has an effect on their susceptibility to C. lagenarium; in general, older leaves are more resistant. Different pH optima were observed for lesion development on leaves of different ages when unbuffered conidial suspensions were applied. The optima were the same with the application of buffered suspensions.

The guttation of cucumber plants has an effect upon the severity of the disease incited by C. lagenarium. Fewer lesions appeared on portions of undipped leaves of cucumber plants when guttation fluid movement was stopped or reduced in amount by the application of a petrolatum barrier, but no reduction of lesions occurred when the leaves were dipped in water before the application of the barrier. More leaf lesions appeared on leaves of cucumber plants kept under guttation conditions for 24 hours than on the leaves of plants kept under conditions in which no guttation occurred.

No toxin synthesis by cultures of this fungus growing on a basal dextrose-nitrate medium could be detected. Young cucumber plants were used as the assay for toxin activity in cultural filtrate and mycelial mat preparations.

Differences in number of leaf lesions produced by conidia from cultures of C. lagenarium growing on media containing different carbon sources (glucose, galactose, lactose, and sucrose) were not significant.

The partial etiolation of young cucumber plants did not increase their susceptibility to C. lagenarium, as evidenced by lesion counts, but appeared to be more severely damaged when exposed to the same amount of inoculum as plants kept in the light.

SUMMARY

The gelatinous matrix, in which the conidia of C. lagenarium are borne, may inhibit the germination of conidia depending upon its concentration. Enough matrix surrounds each conidium, as it is borne in the acervulus, to inhibit its germination.

Diffusates of cucumber leaves affect conidial germination; distilled water washings of cucumber leaves promoted the germination of conidia of C. lagenarium, and guttation fluid inhibited or promoted germination, depending upon the concentration of fluid and the "germinability" of the conidia.

The initial hydrogen-ion concentration for germination of conidia of C. lagenarium in unbuffered glucose solutions was pH 3.5, with a second peak at 11.5; germination was poor at or near the neutral point. Germination was increased across the middle portion of the pH range in unbuffered leaf washings. Conidia did not germinate in sodium borate and phthalate buffered glucose solutions, and did germinate only at a very low percentage in the acid ranges of sodium citrate-buffered glucose solutions. With the addition of leaf washings germination was greatly increased in the acid ranges and germination occurred in the alkaline ranges of the sodium citrate system.

The initial hydrogen-ion concentration has little effect on appressorium formation of conidia in contact with thin, hard substrates, but may have an effect when the conidia are in contact with softer substrates. Washed and unwashed conidia do not differ in percentage appressorial formation.

The optimum pH values for lesion development on cucumber leaves were pH 6.0 and 7.5 with the application of both buffered and unbuffered conidial suspensions. Leaf lesion development was not correlated with conidial germination on glass slides.

In addition to the evidence that the matrix accompanying 60,000 conidia per ml. would promote conidial germination, data were obtained that supported conclusions that the same amount of matrix also promoted lesion development. The dipping of cucumber plants in water before inoculation did not affect the number of resulting leaf lesions.

The guttation of cucumber plants has no effect upon the severity of disease incited by C. lagenarium. The severity of disease was increased under most of the conditions under which it was studied.

No toxin synthesis by C. lagenarium cultures growing on a basal dextrose-nitrate medium could be detected.

Conidia from cultures growing on 4 different carbon sources did not differ in their effect on cucumber plants, as evidenced by lesion counts.

The partial etiolation of young cucumber plants did not increase the number of leaf lesions, as compared with those of plants kept in the light, but it was observed that the partially etiolated plants were more severely damaged.

Microfilm $2.50; Xerox $4.60. 89 pages.

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Abstract published by special arrangement with The Ohio State University.

CHEMISTRY, GENERAL

THE VAPOR PRESSURES OF MOLYBDENUM OXIDES AND TUNGSTEN OXIDES

(L. C. Card No. Mic 59-6620)

Paul Edward Blackburn, Ph.D.
The Ohio State University, 1954

A study of the solid-vapor equilibrium of the molybdenum-oxygen and tungsten-oxygen systems was carried out by measuring the vapor pressures over the oxides, using the Knudsen rate of effusion method.[1]

Theory

The Knudsen rate of effusion method consists of measuring the rate at which gas molecules escape through an orifice in the wall of a cell in which the gas is in equilibrium with a solid or liquid. The equation for the pressure of a gas determined by the rate of effusion method is[2]

$$p = \frac{m}{K}\sqrt{\frac{2\pi RT}{M}} \qquad (1)$$

in which m is the rate of effusion in grams per square centimeter per second, K is the Clausing factor for flow of gases through a tube at low pressures,[3] R is the gas constant, T is the absolute temperature and M is the molecular weight of the gas.

The pressure of a gas in equilibrium with a solid or liquid may be expressed as a function of the temperature, using the Clasius-Clapeyron equation

$$\ln p = \frac{-\Delta H}{RT} + C \qquad (2)$$

in which ΔH is the heat of sublimation or vaporization, T is the absolute temperature, and C is a constant. If heat capacity data are available for the gas and condensed phase, then an expanded form of equation (2) which may be extrapolated with greater accuracy can be used. If the difference in heat capacities is

$$\Delta Cp = \Delta a + \Delta bT - \Delta CT^{-2} \qquad (3)$$

then equation (2) becomes

$$-R\ln p = \frac{\Delta H_o}{T} - \Delta a \ln T - \frac{\Delta b}{2}T + \frac{\Delta C}{2}T^{-2} + I \qquad (4)$$

in which I is a constant and ΔH_o is the heat of vaporization.[4]

Apparatus

All heating was done by induction, using a General Electric or a Westinghouse 20 kilowatt electric heater.

Three vacuum furnaces were used for the vapor pressure determinations. In all three furnaces the vacuum was 1×10^{-5} millimeters of mercury or better. The molybdenum trioxide and molybdenum trioxide-molybdenum dioxide mixtures were run in a pyrex furnace fitted with a platinum to platinum-10%-rhodium thermocouple. The shielded thermocouple in which the radio frequency currents were filtered out by a π filter had been carefully calibrated both before installing in the furnace and in situ.

The other vapor pressure determinations were made in either a pyrex glass furnace or a water-cooled brass furnace. In both of these furnaces all openings were sealed with dry "O" rings. Temperatures were measured with a Leeds and Northrop optical pyrometer which was calibrated at frequent intervals with the removable optical flat windows from the furnaces placed between the pyrometer and the standard lamp.

The cylindrical platinum Knudsen cells which were drawn from a 0.010 inch sheet of metal were fitted with either blackbody wells, for measuring the temperature with an optical pyrometer, or with thermocouple wells which fitted over the hot junction of the thermocouple. All cells were made with the orifice in the side of the cell.

Samples

The molybdenum trioxide, molybdenum, and tungsten powders were obtained from commercial sources. The tungsten trioxide was prepared by dehydrating commercial tungstic acid. The molybdenum dioxide and tungsten dioxide were prepared by heating mixtures of the metal and the trioxide in an inert atmosphere.

Experimental Results

Molybdenum Trioxide

The vapor pressure of molybdenum trioxide obtained from this study is given by rearranging equation (4)

$$\log p = \frac{-18164}{T} - 1.04 \log T - 6.45 \times 10^{-4}T + \frac{-4.02 \times 10^{4}}{T^{2}} + 19.585 \qquad (5)$$

in which the constants from equation (3) for ΔCp are from Cosgrove and Snyder's heat capacity equation[5] for the solid, and from an assumed heat capacity of 18 calories/degree for the gas.[6] The heat of sublimation at 298.16°K was calculated as 80,970 calories.

From an X-ray analysis of the condensate and a calculation using free energy values of Thompson,[7] Cosgrove and Snyder,[5] Kelley,[8] Brewer,[9] and vapor pressure data determined in this research, it was established that the vapor phase was molybdenum trioxide gas.

Mo_4O_{11}

A series of runs was made at 880°K on a mixture of molybdenum trioxide and molybdenum dioxide in which the

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

initial oxygen to molybdenum ratio was 2.768. When the oxygen to molybdenum ratio reached 2.75 because of the vaporization of molybdenum trioxide, there was a drop in the pressure measured from 2×10^{-5} atmospheres to 6×10^{-6} atmospheres. There was no further drop in the pressure as the oxygen to molybdenum ratio was decreased to 2.0. This shows that Mo_4O_{11} exists as a stable oxide at 880°K.

The vapor pressure over Mo_4O_{11} was determined by measuring the pressure over a mixture of molybdenum trioxide and molybdenum dioxide. A least squares fit of the data in which the deviation from the curve was assumed to be in log p gave an equation for the pressure

$$\log p = \frac{-15009}{T} + 11.891 \qquad (6)$$

The heat of sublimation from equation (6) is 68,680 calories for the reaction

$$1/3\ Mo_4O_{11} = 1/3\ MoO_2 + MoO_3(g)$$

Molybdenum Dioxide

The vapor pressure of molybdenum dioxide is given in equation (7), which is obtained by least squares fit, assuming the deviation from the curve to be in log p

$$\log p = \frac{-17873}{T} + 6.035 \qquad (7)$$

The heat of sublimation calculated from the slope in equation (7) is 81,780 calories.

An X-ray pattern of the condensate, as well as equilibrium constants computed from the thermal data of Thompson,[7] showed that molybdenum dioxide gas was the vapor phase.

Molybdenum Sesquioxide

The vapor pressure over a mixture of molybdenum dioxide and molybdenum is given by

$$\log p = \frac{-29098}{T} + 11.769 \qquad (8)$$

From the slope of equation (8) the heat of sublimation, 133,140 calories, is calculated.

The vapor phase was shown to be molybdenum dioxide gas by an X-ray analysis of the condensate, and molybdenum sesquioxide was considered to be the most likely solid phase.

Tungsten Trioxide

The vapor pressure of tungsten trioxide is given by

$$\log p = \frac{-23591}{T} + 12.070 \qquad (9)$$

The heat of sublimation derived from the slope of the curve is 107,940 calories.

The condensate gave X-ray powder lines corresponding to tungsten trioxide, while calculations using Kubachewski and Evans's equations[6] derived for the free energy of formation of tungsten dioxide and tungsten trioxide, together with the free energy of vaporization from equation (9), showed there was negligible dissociation of the trioxide gas.

Tungsten Dioxide

The tungsten dioxide was found to disproportionate according to the following reaction

$$3/2WO_2\ (s) = WO_3\ (g) + 1/2W$$

The pressure over tungsten dioxide was found to be

$$\log p = \frac{-19702}{T} + 9.093 \qquad (10)$$

which gave a heat of sublimation of 90,150 calories.

Conclusion

In the molybdenum-oxygen system there are four oxides which are stable above 800°K. These are molybdenum trioxide and Mo_4O_{11}, which vaporize to molybdenum trioxide gas, and molybdenum dioxide and molybdenum sesquioxide, which vaporize to molybdenum dioxide gas.

The two tungsten oxides, tungsten trioxide and tungsten dioxide, both vaporize to tungsten trioxide gas.

Microfilm $2.50; Xerox $4.20. 76 pages.

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Abstract published by special arrangement with The Ohio State University.

SOME REACTIONS AND PROPERTIES OF TETRALITHIUM PEROXYDIPHOSPHATE

(L. C. Card No. Mic 59-5954)

Clyde Hok Heen Chong, Ph.D.
Michigan State University, 1958

Major Professor: Elmer Leininger

Tetrapotassium peroxydiphosphate was prepared by electrolysis of an alkaline phosphate solution and converted to the lithium salt by the method of Chulski (1). This method was modified to increase the yield to 69 per cent from 38 per cent based on the amount of phosphate originally taken.

It was found that basic or neutral peroxydiphosphate solutions exposed to diffuse light for 12 hours at room temperature or heated at 100°C. for 30 to 60 seconds showed no appreciable loss in oxidizing power.

A method was developed for the determination of manganese based upon the oxidation of manganous ion to manganese dioxide by means of an excess of peroxydiphosphate. The time required for the oxidation of 5 to 50 mg. of manganese was approximately 12 hours at room temperature, four hours at 50-55°C. and 30 to 60 seconds at 100°C.

Two methods were used to complete the determination.

(a) The excess peroxydiphosphate in the filtrate, after removing the manganese dioxide, was determined by reaction with ferrous ion (1).

(b) The manganese dioxide was dissolved in excess ferrous ammonium sulfate and the excess ferrous ion determined by means of potassium dichromate. This method required the use of a correction factor of 1.01.

Despite their interference with the analysis of the filtrates, mercuric, chromic, arsenic(III), chloride and ammonium ions were found to give no adverse effects when the precipitates were analyzed for manganese. Tungstate, thallous, cobaltous, ferric, aluminum, silver, barium, lead, zinc, and nitrate ions interfered in either modification.

The mechanism of the peroxydiphosphate reaction is believed to involve the oxidation of manganous ion to a higher valent species, probably permanganate, which then reacts with manganous ion to form manganese dioxide.

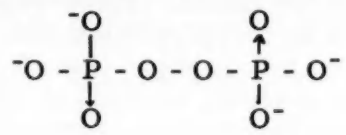
A spectrophotometric method for determining peroxydiphosphate in the ultraviolet region was developed. No definite absorption peaks were obtained, only characteristic curves dependent on concentration and pH. These curves were found to adhere to Beer's Law at 240 mμ and at a pH of 6.0. The method was used for the determination of excess peroxydiphosphate in the filtrate following oxidation of divalent manganese and removal of the precipitate formed.

Individual oxidation of thallous, chromic, and cobaltous ions as well as selenious acid was attempted under various conditions. Although oxidation occurred to some extent, none of these reactions were found suitable for quantitative use. In the presence of a known amount of manganous ions, it was possible to effect quantitative oxidation of thallous and chromic ions. In these reactions, the oxidation of the manganese appears to induce the oxidation of the thallium or the chromium.

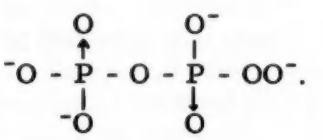
The structure of peroxydiphosphate was investigated. It was shown that decomposition of peroxydiphosphate resulted in the formation of orthophosphate, but no pyrophosphate was detected. Potentiometric titration of peroxydiphosphoric acid revealed that there was one strong hydrogen per phosphorus atom. This was further verified by a conductometric titration.

A nuclear magnetic resonance spectrum revealed only one peak shifted -7.4 parts per million relative to 85 per cent orthophosphoric acid which suggested the symmetrical structure.

The foregoing series of investigations indicated that the structure of peroxydiphosphate must be



and not



REFERENCE

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Microfilm $2.50; Xerox $6.40. 132 pages.

HYDROXYAZO DYES AS METAL ION INDICATORS

(L. C. Card No. Mic 59-5670)

Frederick John Lindstrom, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Harvey Diehl

The discrepancies between the findings of Schwarzenbach and Biedermann and American workers on the properties of Eriochrome Black T and its calcium and magnesium derivatives has been resolved by the preparation of a pure crystalline form of the dye and measurement of its properties and reactions.

Commercial Eriochrome Black T was purified by the removal of some 30 percent inorganic salt from the dried material by repeated extractions with dilute hydrochloric acid. A pure product was then obtained by recrystallization from dimethylformamide. Ultimate analysis of the crystalline material showed it to be the dimethylammonium salt and this was confirmed by identifying and determining the dimethylamine present. The free acid form of the dye was prepared from the crystalline material and found to be very hygroscopic.

The combining ratio of Eriochrome Black T and magnesium at pH 8 was shown to be one to one. The value of the log apparent stability constant for the magnesium compound at pH 8 was found to be log $K_{8.00} = 3.60$. At pH 10 the combining ratio of Eriochrome Black T and magnesium was found also to be one to one using the method of continuous variations; log $K_{10.00} = 5.75$. The combining ratio of Eriochrome Black T and calcium was determined at pH 10 using the log-ratio method and found to be one to one; log $K_{10.00} = 3.84$.

Earlier American work, using preparations of the dyestuff of doubtful purity, has been shown to be wrong.

Since Eriochrome Black T is very unstable in solution new indicator dyes were prepared as stable substitutes for the older indicator. One of these was prepared by coupling 1-diazo-2-naphthol-4-sulfonic acid to p-cresol. This dye was found to give somewhat better end-points than those obtained with Eriochrome Black T and aqueous solutions of the dye should be kept for extended periods of time. A crystalline p-toluidine salt derivative was prepared, analyzed and used for an investigation of the properties of the dye and its calcium and magnesium derivatives. The combining ratio of the p-cresol determined and magnesium at pH 10 was shown by the method of continuous variations to be one to one. The combining ratio of the p-cresol indicator and calcium was determined at pH 10 using the log-ratio method and also found to be one to one.

The new dye was used successfully in the determination of the calcium and magnesium in dolomite with EDTA, and the effect of interferences was studied.

Another dye was prepared like the p-cresol dye with a methyl group adjacent to the hydroxyl group on the phenyl ring. It was hoped that the blocking action of this added methyl group would make this indicator more sensitive for magnesium ion than for the larger calcium ion. While the stability of the calcium compound was decreased more than the magnesium compound, the effect was too small to be of analytical interest.

Microfilm $2.50; Xerox $7.00. 149 pages.

VOLTAMETRIC STUDIES OF METAL COMPLEXES

(L. C. Card No. Mic 59-5565)

Albert Edwin Martin, Ph.D.
The University of North Carolina, 1959

Supervisor: Charles N. Reilley

Part I

The use of polarized mercury electrodes for the (ethylenedinitrilo)tetraacetic acid titration of calcium and copper are evaluated. The procedure is simple: to the titrate metal ion, in an appropriate buffer, is added a solution of HgEDTA; the resulting solution is titrated with standard EDTA. The end point is obtained by one of the following methods: Method I, a potentiometric titration at constant current using two mercury indicator electrodes; Method II, an amperometric titration at constant applied voltage using one mercury indicator electrode; Method III, an amperometric titration at constant applied voltage using two mercury indicator electrodes.

The accuracy obtained is equivalent to that of a conventional potentiometric (i.e., at zero current) titration using the mercury electrode, but offers several advantages, among which are simplicity of electrode system and its maintenance, elimination (in Methods I and III) of a reference electrode and associated salt bridge, rapidity and stability of electrode response and readily obtainable end points without plotting.

The shape of the titration curves is explained by consideration of the pertinent equilibria and electrode reactions as elucidated from current-voltage and current-time curves. The effects of pH, buffer type and concentration are examined to aid in the determination of optimum titration conditions. Possible applications are suggested.

Part II

Equations, which permit the direct calculation of the faradaic impedance of an electrode reaction, are derived. The equations are designed to replace the commonly used vector diagram with an equivalent mathematical expression, thus eliminating a tedious vector construction. The derivation, assuming a given model for the cell, is carried out by summation of the impedances of the parts, rationalizing into real and imaginary terms. Each term is then individually evaluated. The equations are theoretically evaluated under certain limiting conditions for the electrical analogue of a cell. Modifications of the derived equations to fit specific conditions and possible applications are mentioned.

Part III

The polarography of the diethylenetriamine-pentaacetic acid (DTPA) and hydroxyethyl-ethylenediamine-triacetic acid (HEDTA) complexes of cadmium is described. The influence of "inert" salts on the polarographic behavior of Cd-DTPA and Cd-HEDTA is examined in the light of recent theories of electrostatic repulsion. Kinetic waves of two different types were found in the polarographic reduction of Cd-DTPA. Between pH 2 and 4 a kinetic wave attributed to uncomplexed cadmium ion occurs. In the pH region from 2 to 6 a second wave, from the reduction of a species $[CdYH_2M]$, occurs; its height is controlled by the rate of an ionic association reaction between CdY^{-3}, protons and "inert" salt cations, M^+. At pH values above 6, no reduction wave of the complex occurs. In the pH region from 4 to 6, the wave height is strongly dependent on the type and concentration of "inert" salt present in solution. The kinetic waves may be attributed to the slow rate of formation of reducible species from the bulk constituent in solution. From an experimental evaluation of the limiting current dependency on pH and pM, mechanisms leading to the reducible species in the various pH regions are proposed. The height of the reduction wave of Cd-HEDTA is diffusion controlled and independent of pH. The current-voltage characteristics, however, are strongly influenced by the concentration of "inert" cations present in solution. An experimental evaluation of the current dependency, at small current densities, led to the conclusion that the Frumkin theory does not account for the observed behavior of the reduction wave of Cd-HEDTA. An alternative explanation, based on the formation of ion pairs, is offered.

Microfilm $2.50; Xerox $7.20. 151 pages.

EFFICIENCY OF SOLVENTS IN GAS CHROMATOGRAPHY

(L. C. Card No. Mic 59-6498)

Harold Monroe McNair, Ph.D.
Purdue University, 1959

Major Professor: Thomas De Vries

This study concerns solvent efficiency in gas chromatography. Solvent efficiency is defined as the ratio of the retention volumes for two solute concentration maxima. By close control of operating parameters such as column temperature, rate of gas flow, weight of solvent per column length, and method of packing columns these retention volume ratios will show only solvent effects. These solvent effects are determined by the intermolecular forces between solutes and solvents. These van der Waal's forces are known as London's dispersion force, Debye's induction force, and Keesom's orientation force.

Solvents used for this study were: n-octadecane, 1-octadecene, squalane, Apiezon J, stearyl alcohol, G. E. silicone rubber gum, methylphenyl silicone, dinonyl phthalate, 12-hydroxy stearyl alcohol, 9,10-octadecen-1,12-diol, Ucon-Polar, tritolyl phosphate, 1,2,6-hexantriol and 1,2,3-tris-(2-cyanoethoxy)-propane. These solvents are arranged in order of increasing polarity as determined by ratios of retention volumes of samples of alkanes, olefins, alkyl halides, aromatics, napthenes, esters, ethers, alcohols, aldehydes, and ketones. Four foot columns of 30 per cent by weight of solvent to inert support were used. Sample sizes of one microliter/component were detected by a Gow-Mac Model 9285 (pretzel design) four filament, hot wire thermal conductivity cell. Three hundred miliamperes of wire current were used for the 60 milliliters of helium per minute flow rate. A homemade full Wheatstone bridge was used to adjust the filament output fed to a Leeds and Northrup Model "G" 10 mv. recorder. Both column and detector were kept at constant temperatures of 55°, 100°, and 153°C. by means of a vapor reflux jacket.

Data summarized in the appendix are: absolute retention volumes for 50 samples on all solvents at 55°, 100°, and 153°C. where possible; relative retention volumes at the three temperatures to indicate selectivity among different classes of compounds; corrected retention volumes per gram for those solvents which remained intact at operating temperatures; and the constants for an Antoine type equation for squalane, 9,10-octadecen-1,12-diol, Ucon-Polar, and 1,2,3-tris-(2-cyanoethoxy)-propane.

A correlation between retention volumes and Hildebrand's solubility parameter was found to be limited to non-polar solutes on non-polar solvents. In an attempt to correlate solutes which exhibit different intermolecular forces, a general equation for retention volumes as a function of the classical van der Waals' forces was set up. No quantitative correlation is possible at the present time due to lack of data and assumptions made, but qualitatively it points out the properties of solutes and/or solvents to be considered in effecting a chromatographic separation. No single physical property determines retention volumes, but dipole moment of the solvent is very important for the separation of different classes of compounds.

Squalane is reported as the best solvent for alkanes, and 1,2,3-tris-(2-cyanoethoxy)-propane is most efficient for olefins, aromatics, napthenes, alcohols, esters, ethers, alkyl halides, aldehydes and ketones. The nitrile groups seem to be responsible for the selective partitioning. As a solvent of universal applicability 9,10-octadecen-1,12-diol is recommended over dinonyl phthalate.

Microfilm $2.50; Xerox $4.20. 80 pages.

A FURTHER STUDY OF THE RUTHENIUM-THIOCARBANILIDE SYSTEM

(L. C. Card No. Mic 59-6441)

Kenneth Lee Parks, Ph.D.
The University of North Carolina, 1959

Supervisor: Samuel B. Knight

The known reaction of ruthenium(III) chloride with thiocarbanilide has been investigated for its general applicability to the colorimetric estimation of ruthenium. The nature of the complex species formed has been determined, and an over-all equilibrium constant for the formation of a three-to-one ligand to metal complex has been evaluated. The kinetics of the reaction have also been studied.

Microfilm $2.50; Xerox $3.00. 41 pages.

A METHOD FOR THE DIRECT VOLUMETRIC DETERMINATION OF SULFATE

(L. C. Card No. Mic 59-6639)

Robert Llewellyn Stoffer, Ph.D.
The Ohio State University, 1954

That there is no universally accepted method for the volumetric determination of sulfate seems evident from the large number of papers that have been published on this subject and from the widely varying conclusions reached by the different investigators as to the procedure to employ. Many of the proposed procedures have not proved to be very satisfactory. The purpose of the present investigation was to develop a direct volumetric procedure with a readily detectable end point for the determination of sulfate.

The best possibility for developing a new and satisfactory method seemed to be a titration based on a pH change at the end point of a titration of sulfate with standard barium solution. At first it was hoped that ordinary acid-base indicators could be used to detect this pH change, but it was found necessary to use a glass electrode as the indicator because the pH change in all the methods tried was neither very sharp nor very extensive.

The use of a small amount of carbonate as an indicating agent was first studied. If carbonate is precipitated at the end point of a sulfate determination, the pH will drop because hydrogen ions, which were previously tied up by the carbonate ions, are released. When titrations were carried out using carbonate as an indicating agent, the maximum pH change obtained was approximately one pH unit. The pH change in these titrations did not occur as rapidly as with an acid-base titration, and the pH would drift with time after an addition of barium chloride had been made.

By adding ethanol to the sulfate solution, the pH change was increased to a maximum of approximately three pH units. When dibasic potassium phosphate or potassium chromate was used as the indicating agent, a slightly sharper drop in the pH was obtained.

To develop a suitable procedure for the determination of sulfate, a systematic set of experiments was carried out to determine the best medium and the best indicating agent. A 50 per cent ethanol solution was found to be the best medium, and 5 drops of 0.1 M dibasic potassium phosphate was found to be the best indicating agent. In order to obtain reproducible titration curves, the same rate of addition of the barium chloride titrant was used in all of these experiments.

During the course of these experiments it was found that even when there was no indicating agent present, a pH change occurred during the formation of barium sulfate from potassium sulfate and barium chloride. The presence of ethanol greatly increased the extent of this pH change also. When 0.1 M barium chloride was added to a 50 per cent ethanol solution of 0.05 M potassium sulfate, the pH rose gradually to a maximum of about 10 just before the equivalence point, and then dropped more rapidly through the equivalence point to about 6.5. The extent of the pH change was about the same whether indicating agents were used or not, but the pH change was sharper when indicating agents were used.

This change in pH is ascribed to hydrolytic adsorption, i. e., the adsorption of hydrogen ions or hydroxyl ions on the surface of the barium sulfate precipitate. The total amount of adsorption is dependent upon the total surface area of the precipitate, and hence upon the particle size. The type of medium, rate of mixing, and concentration of the reagents affect the particle size of a precipitate and consequently the pH change.

A pH change also occurs during the precipitation of barium iodate, lead iodate, lead sulfate, silver iodate, and silver chloride, although the pH change which occurs with the formation of silver precipitates is very slight. It appears that the extent of hydrolytic adsorption also depends upon the specific nature of the precipitate.

In the proposed procedure for the determination of sulfate, a definite pH value on the titration curve near the equivalence point was selected as the end point. Since this pH value may not occur at the equivalence point, it is advantageous to standardize the barium chloride solution empirically by using the same procedure as that used to determine sulfate in unknown samples.

According to the recommended procedure, the sulfate sample is dissolved in 25 ml. of water, and 25 ml. of 95 per cent ethyl alcohol and 5 drops of 0.1 M dibasic potassium phosphate are added. After the pH of the solution is adjusted to a value between 8.90 and 9.00, the titrant is added at a rate of 5 ml. per minute until the pH begins to drop rapidly. At this point the rate of addition is slowed to one drop per 15 seconds until the pH of the end point, 7.70, is reached. A moderately high rate of stirring is used, and a glass electrode is used to determine changes in pH.

By using 0.02 M barium chloride as a titrant, potassium sulfate samples containing about 75 mg. of sulfate could be titrated with an accuracy of about 5 parts per 1000. As the amount of the sulfate in the samples decreased, the degree of accuracy diminished quite rapidly.

The interferences of potassium, sodium, magnesium, calcium, ammonium, chloride, nitrate, and phosphate ions were studied. It was found that all interfere to a large extent, except potassium, sodium, and chloride.

Various methods were used in an attempt to remove calcium and magnesium from sulfate samples before determining the sulfate. The most successful method was to precipitate them as the carbonates. The resultant relative errors in the determination of an approximately 75 mg. sulfate sample containing 50 mg. each of magnesium and calcium were about 2 per cent and were always positive.

The proposed procedure was applied to the determination of the sulfate content in mixtures of sulfuric and hydrochloric acids. The relative errors ranged from about 0.5 per cent in solutions containing 5 times as much sulfuric acid as hydrochloric acid to about 4 per cent in solutions containing one half as much sulfuric acid as hydrochloric acid. The amount of sulfuric acid in all the samples was about 78 mg.

Microfilm $2.50; Xerox $3.00. 57 pages.

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A STUDY OF THE VOLATILE CHARACTERISTICS OF VARIOUS METAL β-DIKETONE CHELATE COMPOUNDS

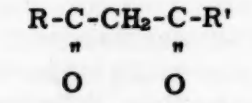
(L. C. Card No. Mic 59-5529)

Joseph T. Truemper, Ph.D.
Louisiana State University, 1959

Supervisor: Professor E. W. Berg

The metal chelates of β-diketones are unusual in that they are volatile to some extent. The degree of volatility of these compounds has never been thoroughly investigated. Furthermore, no attempt has been made to relate the volatile property with compound characteristics such as the nature of the central metal atom and the structure of the β-diketone. A study was undertaken to investigate these points in order to develop concepts of techniques of separation and purification of metals, based on volatilization.

Vapor pressure-temperature data was determined for a series of β-diketone chelate compounds. The ligand was varied by systematic substitution of alkyl, fluorinated alkyl, aromatic and heterocyclic groups in lieu of R and R' in the formula:



The molar heats of sublimation of these compounds were calculated from the vapor pressure-temperature data and were used as the criterion for the degree of volatility as follows: the higher the molar heat of sublimation, the less volatile the compound and vice versa.

The degree of volatility appeared to be related to the molecular symmetry and polarity of the molecules as follows: Spherical molecules (given by a tetrahedral and octahedral arrangement of the coordination bonds of the central metal atom) of the non-fluorinated compounds were more volatile than flat molecules (given by a planar arrangement of the coordination bonds of central metal

atom). The substitution of the trifluoromethyl for a methyl group gave rise to a different trend in volatility. This trend appeared to be related to the polarity of the molecules. The more polar molecules being less volatile. The substitution of aromatic and heterocyclic groups affected the volatility of the molecules. Their effect appeared to be related to the alteration of the polarity of the molecules on the basis of possible resonance contribution. The temperature at which sublimate was first observed on a cold finger in an evacuated vertical sublimator was determined. These temperatures were intended to be a guide in establishing relative degrees of volatility. However, the observed temperatures appeared to be the temperatures at which diffusion to the cold finger took place at a noticeable rate. This phenomena is related to the parameters of molecular weight and diameter of the molecules rather than to the parameters of molecular symmetry and polarity which apparently are related to the degree of volatility.

The thermal stability of these compounds was found to be less than what was expected. The more stable decomposed at 150°-200° C and the less stable around 100° C. The order of thermal stability, when arranged according to the central metal atom, somewhat resembled the order of solution stability that has been reported for a large number of chelate compounds.

Some qualitative separations of metal β-diketone chelate compound were done. The separations were accomplished in a vertical sublimator. Beryllium was separated from iron and copper; cobalt from nickel; and finally, beryllium from copper and nickel and the copper in turn from the nickel.

Further investigations involving other compounds is suggested along with studies towards the development of analytical techniques, based on volatilization. The need to study magnetic susceptibilities, dipole moments and polarizabilities of these compounds in order to clarify points involving molecular symmetry and polarity is mentioned.

Microfilm $2.50; Xerox $5.20. 101 pages.

CHEMISTRY, BIOLOGICAL

CHARACTERIZATION OF THE BASIC PROTEIN OF BOVINE SPERMATOZOA BY ELECTROCHROMATOGRAPHIC METHODS

(L. C. Card No. Mic 59-5633)

Robert Eddy Berry, Ph.D.
University of Missouri, 1959

Supervisor: Dr. Dennis T. Mayer

This study was to investigate the existence of a basic protein of the histone or protamine type in bovine spermatozoa and to accomplish its isolation and characterization. A simultaneous collative study of this protein with a representative type from the germ cell of a lower species, a somatic cell, and immature bovine spermatozoa was undertaken.

Samples of mature bovine spermatozoa were obtained by the artificial vagina technique, from herd bulls of the Missouri Station dairy herd. A method was devised for the extraction of spermatozoa from the outer layers of the testis and the upper epididymal tract for use as a source of immature spermatozoan basic protein. Calf thymus gland nuclei histone and salmon spermatozoan protamine were chosen as the other representative types and were obtained commercially.

After several preliminary schemes a method for extraction of the basic protein from the spermatozoa was achieved. This involved: (1) preliminary use of high speed homogenization with micro glass beads; (2) prolonged extraction, under refrigeration, with dilute acid and strong salt solutions; and (3) final precipitation with ammonia. The results of a picrate test for protamine, as well as other conditions of isolation, gave indications of a histone-like character.

Hydrolysis of these proteins was accomplished in sealed tubes using a steam autoclave and hydrochloric acid solution. The four protein hydrolysates were compared qualitatively using one-dimensional and two-dimensional paper chromatography with butanol, ethanol, acetic acid and water solvent mixtures and ninhydrin developing solutions. The mature and immature bovine spermatozoan basic proteins appeared to be qualitatively similar to calf thymus histone but grossly different from salmon spermatozoan protamine. The histones were comprised of serine, glycine, arginine, glutamic acid, threonine, alanine, proline, valine, norvaline, isoleucine and leucine. The salmon spermatozoan protamine contained valine, threonine, alanine, glycine, serine and arginine.

The proteins were also compared qualitatively by gross electrophoretic and electrochromatographic patterns. The thymus gland histone had an electrophoretic migration of 0.05 Cm./hr., salmon protamine 0.21 Cm./hr. and the two bovine spermatozoan basic proteins did not exhibit electrophoretic migration. Electrochromatographic patterns indicated a higher degree of heterogeneity in the bovine spermatozoan proteins.

An electrochromatographic method was developed for the quantitative recovery and estimation of acidic : neutral : basic amino acid ratios. These ratios were determined in the protein types and compared. Typical results on a molecular percentage basis were: salmon sperm protamine 0:23:77; thymus gland histone 4.6:69.2:26.2; mature bovine sperm histone 5.6:75.0:19.4; and immature bovine sperm histone 13.4:77.8:8.8.

Indications are that the mature bovine spermatozoan basic protein is definitely of the histone type. The immature bovine spermatozoan protein is more complex, containing a higher degree of acidic and neutral amino acids. This protein is also much lower in its basic amino acid content and is more similar to general tissue protein.

It appears that the spermatozoan histone may reflect the degree of complexity of the nucleic acid to which it is attached. The process of spermatozoan maturation also may be reflected in certain changes which occur in the histone, comprising a process of molecular simplification. This offers suggestions for theories of the occurrence and formation of the basic proteins, which require further experimental data for their complete elucidation.

Microfilm $2.50; Xerox $6.00. 123 pages.

BIOSYNTHESIS OF CLAVINE ALKALOIDS

(L. C. Card No. Mic 59-5456)

Lynn Robert Brady, Ph.D.
University of Washington, 1959

Chairman: Dr. Varro E. Tyler, Jr.

The investigation reported here is an attempt to increase the yield of clavine alkaloids in culture media inoculated with Claviceps and to elucidate the biochemical pathways of synthesis of these alkaloids.

The influence of certain modifications of the nutrient medium on clavine alkaloid accumulation was investigated with two isolates of Claviceps, strains 47A (an elymoclavine-producing strain) and 15B (an agroclavine-producing strain). The cultures were prepared by placing 1250-ml. quantities of a medium in 5-L. Diphtheria toxin culture bottles and inoculating with the desired organism. The cultures were placed in a constant temperature cabinet for the incubation period. Samples were removed aseptically at five-day intervals and assayed for total alkaloids by established methods.

Additions of sucrose, DL-phenylalanine and, to a lesser degree, L-tyrosine exerted a stimulating influence on the accumulation of alkaloids in the media inoculated with strain 47A. A similar effect induced by a low concentration of phosphate was more pronounced and more prolonged. Combinations of the favorable factors elicited various degrees of additive responses. A maximum accumulation of clavine alkaloids in the medium (approximately 1.275 Gm./L.) was observed with a combination of low phosphate concentration and additions of both sucrose and DL-phenylalanine.

Strain 15B accumulated more alkaloids in the control medium than in the media containing any of the additions or modifications which were investigated.

The data from the studies on alkaloid accumulation in the media suggested that the influence of certain nutrient modifications on alkaloid synthesis was masked by a retarded growth rate of the organism. This influence on growth was eliminated by the utilization of a replacement culture technique.

The results obtained with replacement culture studies agree with concepts postulating the necessity of two moieties in the formation of lysergic acid derivatives. The first of these is an aromatic precursor which appears to arise from the aromatic amino acids (phenylalanine, tyrosine and tryptophan) or a related metabolite. The evidence indicates that the second precursor is either succinic acid or a compound easily derived from this plant acid.

DL-5-Hydroxytryptophan did not serve as a substitute for the aromatic precursor in strain 47A. This suggests that the clavine alkaloids are not synthesized according to the hypotheses presented by van Tamelen and Harley-Mason, at least in this strain of Claviceps.

It would appear that L-tryptophan is a more immediate aromatic precursor than the monocyclic amino acids in strain 15B.

The experimental data are consistent with the hypotheses of Wendler, Robinson, Feldstein and Mothes et al., but the data do not permit further evaluation of the validity of the four schemes.

Microfilm $2.50; Xerox $6.00. 121 pages.

EFFECT OF CASTRATION AND TESTOSTERONE PROPIONATE ADMINISTRATION ON THE GLYCINE-2-C^{14} UPTAKE BY GUINEA PIG ORGANS

(L. C. Card No. Mic 59-5488)

Giovanni G. Costa, Ph.D.
University of Oklahoma, 1959

Major Professor: Dr. Charles D. Kochakian

The effects of castration and testosterone propionate administration on several parameters related to protein biosynthesis have been studied in the guinea pig. This animal was chosen because it represents a quasi-ideal system, due to the presence of both "responsive" and "nonresponsive" organs.

Three groups of animals (normal, castrated and castrated receiving testosterone propionate) were used. Forty-seven muscles and ten other organs were dissected from each guinea pig and studied. The organ's weight behavior has confirmed once again earlier observations made by Kochakian and his group. Summarizing, sex organs and several head and neck muscles (temporal and masseter, etc.) decreased their mass as an effect of castration. Testosterone administration tended to restore the primitive weight in these "responsive" organs. No effect was seen following either castration or testosterone administration in the remaining organs, thus labelled "nonresponsive."

We thus had two series of test organs. In the first, net protein biosynthesis could be demonstrated by increase of the total protein nitrogen. In the second, no increase in protein mass could be detected. These two conditions satisfy the requirements for Gale's Conditions I and II.

The all important step represented by the uptake of precursors, both in the presence and absence of androgen, has been studied by means of Glycine 2-C^{14} administration.

We found that glycine was taken up by every organ tested, both in presence and absence of testosterone, thus indicating an underlying basic mechanism independent from androgen control. We also found that the growth induced by testosterone in the responsive organs was associated with an induced glycine uptake, thus revealing the presence of a subsidiary mechanism dependent upon the presence of androgens.

Although the hypothesis that testosterone is responsible for the synthesis of specific protein(s), present to any appreciable extent only in the "responsive" organs would appear very appealing, any conclusion in this series is thus premature.

Chromatographic analysis of some of the responsive organs has shown that a decrease in aspartic acid concentration is a generalized consequence of castration. Also, a block in the "exchange" of glycine was seen in masseter and temporal muscles of castrated animals. Furthermore, the glycine-serine conversion seemed impaired by the removal of the testis. Testosterone was able to reverse this effect.

The possibility that these steps in AAc incorporation and interconversion might be considered as the site of action of testosterone has been discussed.

Microfilm $2.50; Xerox $5.80. 118 pages.

THE ETIOLOGY OF EMACIATION IN MENTALLY RETARDED CHILDREN

(L. C. Card No. Mic 59-6477)

William James Culley, Ph.D.
Purdue University, 1959

Major Professor: Dr. E. T. Mertz

Many of the patients in institutions for the mentally retarded are emaciated. A large portion of these patients are emaciated because it is difficult to feed them sufficient calories. However, some patients appear to be hearty eaters but still remain emaciated. This research was directed toward determining if their caloric intakes actually were large and, if so, why they did not gain weight.

Caloric intake studies showed that six of the twenty-two patients checked actually did have very high caloric intakes.

Metabolic rate measurements were made by use of an insensible weight loss (IWL) apparatus. Although the average of the basal rates of the emaciated patients and the patients of normal weight were in the same range, the expenditure of calories of the emaciated group under conditions of normal activity was much higher than for the patients of normal weight.

Gastrointestinal absorption efficiency was determined by measuring fecal fat and nitrogen. The fecal fats on four of the six patients were marginally high and one of the patients had a distinctly high fecal fat and nitrogen. The poor absorption in this one case was found to be due to a low level of digestive enzymes.

Various blood and urine chemistry determinations yielded mainly normal values, although the albumin to globulin ratios were low. There was not an excessive loss of calories via the urine in any of the patients although abnormal metabolites were found in the urines of some.

Microfilm $2.50; Xerox $3.00. 57 pages.

HEXOSE UTILIZATION STUDIES IN THE RAT

(L. C. Card No. Mic 59-6823)

Bernice Lottie Dmuchowski, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

This investigation was undertaken to determine whether certain D-aldohexoses could be converted to glucose by the rat, and to ascertain the metabolic pathway by which such transformations might be brought about.

For this purpose galactose-2-C^{14}, gulose-2-C^{14}, idose-2-C^{14}, talose-2-C^{14}, allose-1-C^{14}, and altrose-1-C^{14} were synthesized, and administered to rats. Crystalline glucose was prepared from the liver glycogen of each of the animals, and the incorporation of carbon-14 from each of these hexoses determined.

In order to draw any conclusions about the possible metabolic pathway involved, it was necessary to degrade the isolated glucose and determine in which carbon the isotope appeared. For this purpose a chemical method applicable to the degradation of carbohydrates was devised, and suitable experimental conditions to achieve the goal were determined. The reactions involved are:

glucose ⟶ 4,6-ethylidene glucose ⟶ 4,6-ethylidene sorbitol ⟶ formaldehyde (C-1) + formic acid (C-2) + 2,4-ethylidene erythrose ⟶ erythronolactone ⟶ formaldehyde (C-6) + formic acid (C-5) + glyoxylic acid ⟶ glycolic acid ⟶ CO_2 (C-3) + formic acid (C-4)

The studies showed that there was only a slight utilization of gulose and an even lesser utilization of allose. Talose, idose and altrose appear to be inert.

Degradation of glucose obtained from the liver glycogen of the animals to which galactose was administered showed that galactose-2-C^{14} was converted to glucose-2-C^{14}. This eliminated the possibility that muco-inositol, or a derivative of muco-inositol, might be an intermediate in the transformation of galactose to glucose, and confirmed the observation that the biological conversion of galactose to glucose takes place without fragmentation of the carbon chain.

Microfilm $2.50; Xerox $5.80. 120 pages.

THE IN VITRO OXIDATION OF TESTOSTERONE BY GUINEA PIG LIVER

(L. C. Card No. Mic 59-5490)

Gerald Leroy Endahl, Ph.D.
University of Oklahoma, 1959

Major Professor: Charles D. Kochakian, Ph.D.

The physiological effects of androgens and the metabolic products of their breakdown have been investigated and established in experimental animals and humans by in vivo and in vitro methods. Still unanswered are the questions of how the androgens manifest their response and whether reactions occurring in their metabolism are also necessary for their androgenic manifestations. Investigations of isolated enzyme systems often yield valuable information towards the solution of such a problem. The purpose of this dissertation is the study of the in vitro metabolism of testosterone by guinea pig liver in order to contribute information which may in time be helpful in determining how the androgens manifest their physiological effects.

Homogenates of guinea pig liver are capable of using either diphosphopyridine nucleotide (DPN) or triphosphopyridine nucleotide (TPN) as the hydrogen acceptor while oxidizing testosterone to 4-androstene-3,17-dione. The rate of oxidation when DPN is used as hydrogen acceptor is approximately twice that when TPN is used. These two activities in guinea pig liver homogenate were separated by centrifugation showing that the DPN activity was associated with the mitochondrial fraction while the TPN activity was associated with the soluble fraction after centrifugation at 105,400 X G.

The rate of oxidation of testosterone by guinea pig liver homogenates and fractions thereof with appropriate coenzyme (DPN or TPN) was studied under the influence of varying hydrogen ion concentration, pyrophosphate buffer concentration, coenzyme concentration and substrate concentration.

The differences of behaviour of the two systems (DPN or TPN) to the factors above indicate that two different enzymes, one specific for DPN and one for TPN, are associated with the oxidation of testosterone in guinea pig liver. This is proposed and discussed despite the presence of small amounts of transhydrogenase activity in the homogenate and mitochondrial fraction.

A five-fold purification of the TPN active component in the soluble fraction of guinea pig liver homogenate was achieved by ammonium sulfate fractionation followed by separation on a column of N, N-diethylaminocellulose.

The activity of the two systems (DPN and TPN) was determined on seven steroids other than testosterone. Activity was noted only on the 17 -hydroxy compounds. K_s values for testosterone and etiocholan-17 -ol-3-one were determined in both systems.

Seven metal ions had no activating effect when tested with the TPN system using a purified supernatant fraction as the enzyme source.

Microfilm $2.50; Xerox $7.20. 151 pages.

SOME ASPECTS OF THE COORDINATION CHEMISTRY OF CYTOCHROME-c AND VITAMIN B-12

(L. C. Card No. Mic 59-4617)

Stanley Charles Glauser, M.D., Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Philip George

For a ferrihemoprotein in which the iron atom, Fe^{+}, is held in a crevice by bonds to the protein on both sides of the porphyrin ring - e.g. $\overline{\text{protein-Fe}^{+}\text{-X}}$ - reaction with an anionic ligand, L^-, entails breaking the weaker bond - e.g., $Fe^{+}\text{-}X^-$ to give the complex protein $\overline{\text{protein-FeL X}}$. Depending on the pK for the dissociation of $-XH^{+}$ and the pH of the solution, complex formation may be accompanied by the addition of a proton to the group -X which is liberated. The variation of the observed equilibrium constant evaluated:

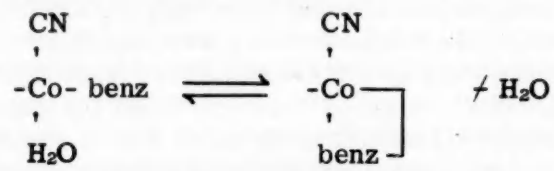
$$K_{obs} = \frac{[\text{complex}]}{[\text{uncombined hemoprotein}] \times [\text{uncombined ligand}]}$$

is given by the theoretical equation,

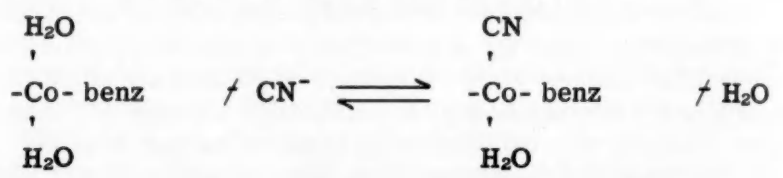
$$K_{obs} = K_L \times \frac{K_{HL}}{K_{HL} + [H^{+}]} \times \frac{[H^{+}]\,([H^{+}] + K_{HX})}{[H^{+}]^2 + [H^{+}]K_{Cr}\,K_{HX} + K_{HX}K_{Fe}}$$

where K_{Cr} is the equilibrium constant for the formation of the crevice structure in the parent hemoprotein $\overline{\text{Pr-Fe}^{+}\,(H_2O)\,X} \rightleftharpoons \overline{\text{Pr-Fe}^{+}\text{—X}} + H_2O$. K_L is the equilibrium constant for the formation of the complex via the coordinated water molecule structure $\overline{\text{Pr-Fe}^{+}\,(H_2O)\,X} + L^- \rightleftharpoons \overline{\text{Pr-FeL X}} + H_2O$; K_{HL}, K_{HX}, and K_{Fe} are the dissociation constants for $HL \rightleftharpoons H^{+} + L^-$, $-XH^{+} \rightleftharpoons -X + H^{+}$, and $\overline{\text{Pr-Fe}^{+}(H_2O)\,X} \rightleftharpoons \overline{\text{Pr-FeOH X}} + H^{+}$ and the condition $K_{HX} > K_{Fe}$ is satisfied. Measurements of K_{obs} for the formation of the azide complex of ferricytochrome-c have been made over the pH range 4 to 7, temperature range 2°C to 25°C, and I = 1.0. Analysis of the variation of K_{obs} with $[H^{+}]$ and temperature indicates that $pK_{HX} = 5.1$ and $\Delta H_{HX} = 6.3$ Kcal/mole at 25°C which is very strong evidence for the identification of X as a histidine group. In addition it appears that another proton-accepting group HC, with a $pK_{HC} = 4.8$ and $\Delta H_{HC} = 8.5$ Kcal/mole at 25°C, is liberated when the crevice is broken to form the complex, and this also appears to be a histidine group.

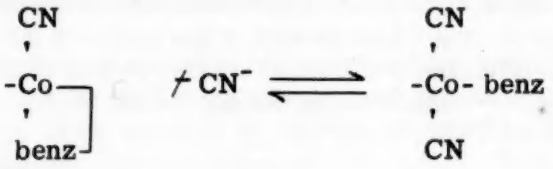
Cyanocobalamin (Vitamin B-12) with its internal complexing of the benzimidazole to the cobalt is a perfect model system to be compared with cytochrome-c in which imidazole is coordinated to iron. The equilibrium constant K_{Cr} for the formation of the crevice in cyanocobalamin is derived from the equation:



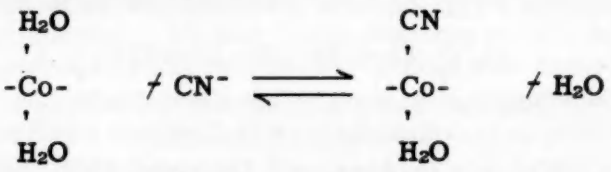
Other reactions that have been studied were:
The first cyanide reacting with diaquocobalamin



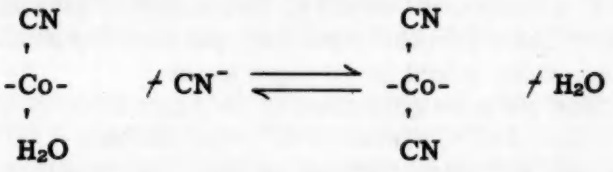
with an equilibrium constant K_{CN_1}, the second cyanide complexing with cyanocobalamin



whose equilibrium constant is given by K_{CN_2}, the first cyanide being bound by aquo-Factor B



K_{CN_1} being the associated equilibrium constant, and the second cyanide reacting with Factor B



which yields the equilibrium constant K_{CN_2}.

In these two biologically important compounds, it is possible to compare K_{Cr}. In cytochrome-c it has a value of 10^3 while in cyanocobalamin it is 10^6. This agrees with the trend in non-biological compounds of Co^{III} where the equilibrium constants are consistently several powers of ten greater than those for the analogous Fe^{III} compounds.

Microfilm $2.50; Xerox $6.80. 145 pages.

THE IN VIVO INCORPORATION OF GLYCINE-1-C^{14} INTO PROTEIN AND NUCLEIC ACID FRACTIONS OF THE NUCLEI OF LIVER AND TRANSPLANTED LIVER TUMOR OF RATS

(L. C. Card No. Mic 59-6434)

David James Holbrook, Jr., Ph.D.
The University of North Carolina, 1959

Supervisor: J. Logan Irvin

The present research was undertaken in order to study the simultaneous incorporation of radioactive glycine into fractionated proteins and nucleic acids of cellular nuclei and to compare the nuclei of relatively slowly dividing liver cells with the nuclei of the more rapidly dividing cells of a transplanted liver tumor.

Glycine-1-C^{14} was injected intraperitoneally into rats bearing a subcutaneously transplanted liver tumor. After various time intervals, nuclei were isolated from liver and liver tumor, and nuclear material was fractionated by the following method: disrupted nuclei were extracted with 0.05 molar sodium citrate solution to yield a soluble fraction (fraction I). The residue from the sodium citrate extraction was further extracted with 1 molar sodium chloride solution to yield soluble (fraction II) and insoluble (fraction III) fractions. Histone, nonbasic protein, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) were isolated from each of the three fractions.

The nonbasic protein fractions of liver had higher specific activities than the corresponding fractions of tumor. This was probably attributable to a more favorable circulation of the intraperitoneally injected glycine-1-C^{14} to the liver than to the subcutaneously transplanted liver tumor. Relative to incorporation into other nuclear proteins of the tissue, incorporation of radioactive glycine into the three histone fractions of tumor was twice as high as incorporation into the histone fractions of liver 20 hours after injection. At short time intervals (0.5 and 1.0 hour), histones II and III of tumor nuclei also showed much greater incorporation than the corresponding fractions of liver nuclei, relative to incorporation into the nuclear nonbasic proteins.

In liver, with the exception of histone I at short time intervals, the nonbasic nuclear proteins (proteins I, II, and III) had higher specific activities than any of the histone fractions. Differences in specific activities were also observed among the nonbasic protein fractions. Unlike the specific activities in other histone fractions, the specific activities of histone I exceeded that of any other nuclear protein fractions of liver at 0.5 and 1.0 hour. Histone I decreased in specific activity during the 1 to 20 hour period after administration of radioactive glycine while the specific activities of other nuclear protein fractions continued to increase and reached a maximum at 20 hours. The very rapid increase in specific activity of histone I at the short time intervals and its subsequent rapid decline at the same time that histones II and III were still increasing in specific activities suggest the possibility that histone I may be a precursor of histones II and III, and perhaps of other nuclear proteins.

In tumor the three nuclear nonbasic proteins had somewhat higher specific activities than the three histone fractions at 0.5, 1.0 and 20 hours, but the differences between these fractions in tumor were not as great as the differences in liver between the nonbasic proteins and histones II and III.

Incorporation of glycine-1-C^{14} into nucleic acid purines was determined 20 hours after injection. Metabolic heterogeneity was observed in the DNA and RNA fractions of both liver and tumor. For DNA fractions of liver or tumor, specific activities were in the order: DNA III > DNA II > DNA I. For RNA fractions from liver or tumor nuclei, specific activities were in the reverse order: RNA I > RNA II > RNA III. Specific activities of the purines from tumor nucleic acid fractions were higher than specific activities of the purines from corresponding liver nucleic acid fractions. It was observed that there was an accentuation of incorporation of radioactive glycine into DNA and into histones of liver tumor, in comparison with liver, but the extent of this accentuation was not equal for these classes of compounds.

Microfilm $2.50; Xerox $5.20. 104 pages.

THE PHYSICOCHEMICAL AND NUTRITIONAL PROPERTIES OF RIBOFLAVIN-ACTIVE SUBSTANCES IN SOYBEAN-OIL MEAL

(L. C. Card No. Mic 59-6569)

William Prentiss Ingram, Jr., Ph.D.
North Carolina State College, 1959

Supervisor: Dr. F. W. Sherwood

Reports in the literature indicate that concentrations of riboflavin in soybean-oil meal obtained by means of the rat-growth method are over twice as great as those obtained by conventional fluorimetric and microbiological methods. A critical study of values and associated procedures led to the belief that the observed differences could not be due to chance. Thus, the objective of this study was to determine the factor(s) involved in the failure of the various methods to yield equivalent estimates of soybean-oil meal riboflavin.

The hypothesis that soybean-oil meal contains riboflavin-active substances(s), other than riboflavin and the known derivatives that occur in nature, was tested. It was assumed that the autoclaving of soybean-oil meal with some concentration of acid greater than 0.1 N but less than 6 N would effectively extract either all or nearly all of the riboflavin-active material, and that exposure to strong light for several weeks would destroy either all or nearly all of the known forms of riboflavin in the extracts. By means of changes in the buffering procedure, the fluorimetric method was modified so that it could be used to estimate the concentration of riboflavin in such extracts. The modified method was found to be satisfactory for acid concentrations of 1.0 N or less but unsatisfactory for acid concentrations greater than 1.0 N. This method indicated that acid concentrations of 1.0 N liberated only slightly more riboflavin than concentrations of 0.1 N or less.

Rat-growth assays of soybean-oil meal fractions indicated that the thoroughly-washed residues remaining after extraction with 0.45 N and 1.35 N sulfuric acid were almost riboflavin-free and that the bulk of the activity was in the extracts. Alsc, it was shown that the acetone-water (1:1) insoluble fraction of an 0.45 N sulfuric acid extract was

riboflavin-free. Further, these rat-growth assays and the growth response of L. casei, ATCC 7469, showed that the photolytic destruction of riboflavin in the extract fractions was incomplete. Because of this result and concomitant evidence that growth-inhibiting substances might be present in the extract fractions, the presence of riboflavin-active substance(s) other than riboflavin and its known derivatives could not be demonstrated in these assays.

If soybean-oil meal contains more riboflavin than indicated by the usual in vitro methods, the rat presumably obtains it with the aid of one or more enzymes of the digestive tract. To test the hypothesis that the usual in vitro methods do not permit measurement of all the riboflavin in soybean-oil meal, the extraction procedures normally used were modified to include incubation processing with enzyme preparations, "clarase," pepsin, and trypsin. Of the various modifications examined, the pepsin-trypsin (PT) and the autoclave-trypsin (ATA) methods were the most thoroughly tested. In the PT method the soybean-oil meal was incubated first with pepsin (pH 1 to pH 2) for 24 hours and then with trypsin (pH8) an additional 24 hours. In the ATA method the soybean-oil meal was autoclaved with sulfuric acid (pH about 2 - 3), incubated for 24 hours with trypsin (pH 8), and re-autoclaved (pH 1.7). Both modifications, by means of fluorimetric and microbiological assays of the extracts, yielded estimates of riboflavin approximately equal to those from rat-growth assays of soybean-oil meal. The ATA method, however, yielded estimates that were significantly greater, statistically, than those obtained by the use of the PT method. Riboflavin and flavin mononucleotide were identified and separated by chromatographic means from the extract prepared by the ATA method. The remaining fraction did not contain significant amounts of riboflavin as indicated by the growth of L. casei, ATCC 7469. This result indicated that riboflavin-active (for L. casei) substances(s) were not present in such extracts. Extract and residue, prepared in quantity by a procedure that included the ATA method, were assayed by the rat-growth method. As before, the residue accounted for only a small fraction of the total riboflavin indicated. The estimate obtained for the extract was greater than the average of estimates obtained by fluorimetric and microbiological assays of extracts prepared by the ATA method, but the difference was not significant statistically.

The greater part of the riboflavin-activity exhibited by soybean-oil meal in the rat is due to riboflavin and to known derivatives of riboflavin, but the possibility remains that unknown substance(s) are responsible for part of the growth-response.

Microfilm $2.50; Xerox $5.60. 115 pages.

THE LIPOLYTIC ENZYME SYSTEMS OF MILK

(L. C. Card No. Mic 59-5362)

Theodore Ferer Irmiter, Ph.D.
The Ohio State University, 1951

One of the major problems encountered in the field of dairy technology has to do with the development of fatty acid flavors in certain products as a result of hydrolytic decomposition of the fat. In its early stages the taste of the product may be only slightly affected, but as the degree of deterioration increases, rancid flavors, attributed largely to release of significant amounts of strong-flavored, volatile fatty acids of lower molecular weights, become increasingly apparent. This development of rancidity has been found to be an important problem in the storage of dried milk products, and particularly in the keeping quality of homogenized milk.

On the other hand, the proper development of flavor in cheese during ripening is thought to be dependent to a certain extent upon the amount and kind of fatty acids liberated from the milk fat present during the ripening of the cheese. Thus the liberation of fatty acids may lead to an undesirable quality in some dairy products but to a desirable quality in others. In either case it is important for the dairy technologist to learn as much as possible about the factors responsible for fat decomposition, and the conditions governing such changes.

It is known that the essential chemical change involves the hydrolysis of the complex mixture of mixed triglycerides found in milk into its component fatty acids and glycerol. Organic chemists state that this reaction may be promoted by high temperature, by alkalies with the formation of "soaps," or by acids. Biochemists add a fourth factor - the fat-splitting enzymes known as lipases which enable fat decomposition to go on rapidly at much lower temperatures than is the case with other hydrolytic agents. Since most of the hydrolytic changes in dairy products are of this latter type, the work reported in the dissertation has to do entirely with the problem of fat changes resulting from the action of the fat-splitting enzymes or the lipases in milk products.

In the strict sense of the term, lipase should be confined to those enzymes which split the fatty acids from mixed triglycerides. Some writers misuse the term "lipase" when they use it to refer to such enzymes as esterases which can cleave fatty-acid esters. These esterases are incapable of hydrolyzing a mixture of mixed triglycerides such as milk fat.[1] This confusion in terminology has led to many erroneous conclusions in connection with investigations of lipase systems in dairy products.

In order to draw any valid conclusions as to the nature and properties of milk lipase, two criteria must be applied:

1. The lipase must act on milk fat in its natural medium.
2. The method used to analyze for the liberated fatty acids must be accurate and give good recoveries of all fatty acids.

Failure to meet either one of these criteria leads to considerable confusion with respect to the nature of lipase activity. The objective of the work described in the dissertation is to develop methods which will allow these criteria to be met.

There are some general conclusions which appear to be fairly well accepted concerning milk lipase. First, it seems that there is more than one type of lipase in milk. Tarassuk and Jack[1] have divided the causes of lipolysis into two broad groups:

1. Activated lipolysis, which results from homogenization, violent shaking of warm milk, and warming of the precooled milk to about 30° C., then cooling it again below 10° C. These treatments lead to distortion of the natural adsorption layer of the fat globules, and therein lies the clue to the mechanism of activation.

2. Spontaneous lipolysis, where the only condition necessary for the initiation of lipolysis is the cooling of the milk. Lipase of naturally lipolytically -active milk is present in milk plasma prior to cooling. When the milk is cooled, the lipase is irreversibly adsorbed on the fat globules, and the lipolysis begins immediately upon the adsorption.

There is other evidence which leads to the conclusion that there may be more than one milk lipase.[2,3,4] Although it has not been conclusively demonstrated, it is thought that there is a certain degree of specificity of milk lipase.[1,5]

The present knowledge of lipase in milk has been reviewed. From this review it is evident that there is much disagreement concerning the activity of lipase in dairy products. It would seem that a great deal of the confusion in determining the extent of lipolysis arises because of the different analytical methods used and the lack of a sensitive analytical method which can be used for such measurements under all conditions. It is doubtful whether the same thing is being measured in all cases.

The present methods available for the determination of fatty acids in dairy products and other biological systems have been reviewed and evaluated. Among the methods studied were:

1. Titration of entire sample[6,7]
2. Removal of the fat fraction by churning[8] or by solvent extraction.[8,9,10] The separated fat fraction is then titrated with standard base.
3. By measurement of surface tension.[11,12]
4. By colorimetric methods.[13]

It was shown in the discussion that the methods which are presently available fail to be of any considerable value for one or more of the following reasons:

1. Only the gross results of lipolysis are measured.
2. Esterase rather than lipase activity is measured.
3. A synthetic medium is used in an unnatural environment.
4. There is incomplete recovery of all of the liberated fatty acids.
5. No means of separating the fatty acids liberated during lipolysis is offered.

As a result of the experimental work the following procedure was evolved for the quantitative separation of mixtures of fatty acids which might be expected to result from lipolytic changes in natural fats.

1. Preparation of the sample.

The sample should be of such a size as to contain a total of 30 to 35 mg. of fatty acids. On fluid milk samples of average fat content, an 8 cc. sample is usually satisfactory. Add 4N H_2SO_4 dropwise until the sample has a pH of 2. Add 15 gm. of dried silica gel and grind to a free-flowing powder in a mortar. The ratio of silica gel to liquid should be kept in the order of 10:4 in order to give the proper rates of flow of solvent through the column. If it is found that it is necessary to change the sample size, the amount of silica gel used must be changed accordingly.

2. Preparation of buffered silica gel column

A phosphate buffer is prepared by mixing equal parts of 2M KH_2PO_4 and 2M K_2HPO_4. The column is prepared by grinding 10 gm. of dried silica gel and 6 cc. of the above buffer into a dry free-flowing powder in a mortar. This powder is slurried with 40 cc. of washed chloroform, which has been equilibrated against the buffer, and poured into a 38 mm. tube. An additional 10 cc. of chloroform is used to rinse the beaker in which the slurry was made, and this rinse is also poured into the tube. The column is packed by the solvent flowing through. The column should be evenly packed and free of air bubbles and channels.

3. Elution of fatty acids

The sample which has been prepared in step 1 is slurried with 40 cc. of chloroform and poured on top of the column prepared in the preceding step. An additional 10 cc. of chloroform are used to rinse the beaker in which the slurry is prepared, and this is also poured into the column. The collection of fractions is started when the sample is added to the column. Each 5 cc. fraction is titrated immediately after it is collected with 0.01N alcoholic NaOH to the phenophthalein end point. When the level of chloroform reaches the top of the silica gel, 140 cc. of 5 per cent butanol in chloroform are added. The first 4 fractions should not contain any fatty acids. The higher fatty acids (caproic and above) will come out in fractions 5 through about 24, depending on the amount present. The butyric acid will come off in fractions 25 through 32, again depending on the amount present. If the titration values are plotted against the fraction numbers as the titrations are made, the separation can be followed very closely.

4. Collection of samples containing the higher fatty acids

After the titration has been completed, the fractions containing the higher fatty acids are pooled, and the flasks which contained them are rinsed three times with small portions of distilled water and the rinse water added to the pooled solvent. Enough water is added to make a total of about 150 cc. of water. The water layer is removed and saved, and the solvent layer is extracted twice more, 50 cc. of water being used each time. The aqueous layers are collected together and evaporated to dryness on a water bath. The temperature of the water solution of the salts should be kept below 60° C.

5. Preparation of the Geon column

Seven hundred and fifty cc. of benzene saturated M-40 solvent are stirred in a 1-liter beaker by means of a magnetic stirrer. Six gm. of Geon are added slowly, and an additional 15 cc. of benzene are added dropwise with continuous stirring. The stirring should be continued for 45 minutes. After this, about 600 cc. of the solvent are poured off and the remainder used to pack the column. A tube 12 mm. in diameter is used here. The swollen Geon is added at the top, and the column packed by allowing the solvent to flow down through it. When the column is packed it should be about 22 cm. long. A small Witte plate is placed on top of the column, and the column is compressed to 20 cm. with a glass rod. After the column is

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completed, it is placed in a water jacket and brought to 20 to 22° C., which temperature must be maintained throughout the run.

6. Separation of the higher fatty acids.

To the dried residue prepared in step 4 is added a quantity of 0.5N H_2SO_4 which is equivalent to the base used to titrate these fractions. About 0.5 cc. will be required, and an excess of mineral acid is to be avoided. The salts are dissolved in the acid by stirring and washing onto the freshly prepared Geon column with 2 to 3 cc. of M-40 solvent which has been saturated with benzene. The dish is rinsed twice with 1 cc. of the M-40, and these rinses are also poured into the tube. The solvent used to pack the column should be drained to the level of the Geon before the sample is added. The 5 cc. of M-40 containing the sample are then allowed to flow into the bed, and 25 cc. of M-40 are added above the column. Five-tenths cc. of benzene is added on top of this solvent to be sure that the solvent is kept saturated with benzene. A total of about 60 cc. of M-40 will be required to elute caproic acid. The bottom stopcock is opened all the way, and a rate of flow of 1 cc. per minute maintained by adjusting the top stopcock.

The first three fractions will be blank, and caproic acid will come off in fractions 4 through 13. One hundred and thirty cc. of M-60 are then added to elute caprylic acid and capric acid. One hundred and fifty cc. of M-65 are then added to elute lauric and myristic acid. Ninety cc. of M-70 will elute palmitic acid and the unsaturated C_{18} acids as a single group. Finally, 90 cc. of M-74 will elute stearic acid. The solvents were prepared by diluting the indicated volume of M solution 3 methanol to 1 acetone with water to make 100 parts. Thus M40 refers to 40 parts M-solution to 60 parts water by volume. All solvents were saturated with benzene prior to use.

The progress of the separation should be followed by plotting the titration values against the fraction number. When this is done, the proper place to change solvents becomes readily apparent. This is especially true if one of the acids is not present. The quantities of solvent given above are approximately correct when 0.1 millimole of each acid is present.

It was found best to use a silica gel column once and discard it after the run was completed. The Geon columns should be used for only one run also, but the Geon can be reclaimed by extracting it continuously with ether for at least four hours. The reclaimed Geon can then be used to prepare a fresh column. New batches of Geon should be checked with mixtures of acids of known composition.

The method described has been shown to be accurate; however, some precautions must be taken. The quantity of each fatty acid used was of the order of 0.1 millimole. In certain cases where one fatty acid occurs in a higher ratio than the others, separation may not be achieved.

Weighed samples of fatty acids were added to buffered cream samples and determined by the procedure outlined. Good separation was obtained, and quantitative recoveries were made.

Two samples of dry whole milk powder (28.5 per cent) were examined according to the procedure outlined above. One sample (Teknican) had an oxidized odor with only a faint trace of butyric acid, and an acid degree of 17. The other sample (Mil-lait) was prepared by addition of a special lipolytic enzyme during processing and had a strong butyric acid odor and an acid degree of 33. The data secured from the separation with silica gel and Geon are given in Table II.

Table I

Separation and Recovery of Fatty Acids from a Milk Sample

Acid	Mg. Acid Used	Mg. Acid Recovered	Per Cent Recovery
Butyric	4.72	4.83	102.0
Caproic	5.07	5.18	102.7
Caprylic	6.41	6.36	99.2
Capric	4.83	4.69	97.0
Lauric	3.03	2.79	92.1
Palmitic	3.44	2.50	72.6

Table II

Fatty Acid Content of Dried Milk Powders Expressed as mg. Acid/gm. Powder

Acid	On Silica Gel			
	Teknican		Mil-Lait	
	mg. Acid.	Fraction	mg. Acid.	Fraction
Caproic and higher	11.26*	6 - 20	11.24*	6 - 21
Butyric	0.28	21 - 36	2.07	22 - 29
	On Geon			
Caproic	0.27	6 - 10	2.84	6 - 11
Caprylic	0.18	15 - 18	3.58	13 - 19
Capric	0.27	18 - 21	3.25	20 - 26
Lauric	0.29	26 - 29	0.71	31 - 36
Higher fatty acids**	(3.58) high		(0.97) low	
Acid degree	17.3		40.2	

*Calculated as caproic. **Myristic acid and higher.

From the data given it is seen that the silica gel procedure shows Teknican to be low in butyric acid and high in the caproic and higher fraction, while the reverse is true of Mil-Lait. The data with Geon likewise show Teknican to be much lower in the volatile insoluble acids (caproic and lauric) than Mil-Lait. From the titration data it is also possible to approximate the total acids present to give a value corresponding to the acid degree measured by the usual procedure. For Teknican the calculated value was 17.3, as compared with the value of 17 given by the usual procedure. For Mil-Lait the value calculated was 40.2, as compared with an acid degree of 33 reported for this sample. If allowance is made for the butyric acid content of this powder, the remaining acids amount to a calculated acid degree of 32.4. Since in the usual procedure, the fatty acids are extracted with ether, it is probable that the butyric acid, being completely miscible with water, is not extracted to any great extent. Thus lower acid degrees result for samples with much butyric acid present.

In using the Geon, incomplete elution of fatty acids of C_{14} and higher was noted in all analyses. Some possible

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reasons for this are the use of reclaimed material in successive runs, the type of elastomer used, the particle size used, the concentration of solvents, the choice of flow rate, and the temperature of the operating column. Further work needs to be done on the effect of all these factors on the quantitative recovery of these higher molecular weight acids.

The procedures developed offer (1) a better method of determining the acid degree of butterfat and its unique butyric acid content; (2) a method of determining the relative amounts of butyric acid and the total of the remaining acids derived from butterfat hydrolysis by the silica gel technique; (3) a means of quantitative separation of all acids in the fat from C_4 to C_{12} by combination of silica gel and elastomer techniques. Such information should be of considerable assistance in future studies of lipase activity under various conditions.

It was also shown that under the conditions used, lactic acid did not interfere. Runs were made on fresh pasteurized cream samples to which no fatty acids had been added. It was found that the cream contained higher fatty acids (C_6 and above) equivalent to 0.2 to 0.3 cc. of 0.01N base and no measurable butyric acid.

Microfilm $2.50; Xerox $5.80. 116 pages.

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STRUCTURE OF δ-CAROTENE; CAROTENES IN TOMATOES.

(L. C. Card No. Mic 59-6485)

Thomas Edward Kargl, Ph.D.
Purdue University, 1959

Major Professor: Dr. F. W. Quackenbush

This thesis has been divided into two sections. The structure of δ-carotene comprises the first section while the second section deals with the carotene-polyene systems in nine homozygous, tomato strains and their possible implications in a hypothetical mechanism of carotene biosynthesis.

δ-Carotene, a crystalline, yellow-orange carotene isolated from tomatoes was shown to have a monocyclic, isoprenic structure whose perhydro derivative (perhydro-δ-carotene) was identical to that of perhydro-γ-carotene. Alkaline isomerization converted δ-carotene to γ-carotene in small amounts while N-bromosuccinimide converted δ-carotene to dehydro-δ-carotene in small amounts. From the physical and chemical properties of δ-carotene, and the isolation of acetone, levulinic aldehyde, methyl glyoxal and glyoxal from its ozonolysis degradation products, the structure of δ-carotene is believed to be the α-ionone analogue of γ-carotene.

The colorless polyenes and carotenes from nine homozygous tomato strains, $B^+B^+mo_Bmo_B$, Rutgers, High β, Intermediate β, High δ, Jubilee, Apricot, Low Total and Low Total Jubilee, have been isolated by adsorption chromatography on magnesiadiatomaceous earth, identified by spectrophotometric curves and determined quantitatively. The differences among the types of carotenes were used to postulate a possible biosynthetic pathway for the carotenes in homozygous tomato strains. In this pathway, phytoene and phytofluene (and possibly ζ-carotene) were postulated as common precursors for all other carotenes. Evidence from literature is presented to support this hypothesis.

Microfilm $2.50; Xerox $4.60. 87 pages.

METABOLISM IN GLYCOLLATE-ADAPTED ESCHERICHIA COLI

(L. C. Card No. Mic 59-6825)

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University of Illinois,
Chicago Professional Colleges, 1959

Escherichia coli have been shown to have an active tricarboxylic acid cycle which supplies carbon skeletons for synthetic purposes.[1,2] When grown on two-carbon compounds, however, other pathways are necessary to account for growth and energy production.

When cell-free extracts of glycollate-adapted E. coli are incubated with 2-C^{14}-glycollate, that compound is slowly converted to glyoxylate. This intermediate is in turn rapidly used to form a compound identified as tartronic semialdehyde. The latter has been detected as hydroxypyruvate by chromatography of the free acid, and of the 2, 4-dinitrophenylhydrazone derivative and by the reduction of that derivative to the amino acid, serine.

Manometric and microtitration experiments with cell-free extracts showed that for each two umoles of glyoxylate used as substrate, approximately one umole of CO_2 was formed and approximately one umole of acid disappeared at a rapid rate. Reduction experiments with DPNH and the same extract showed that for each two umoles of glyoxylate used, one umole of DPNH was oxidized, producing glyceric acid. These data support the hypothesis that two umoles of glyoxylate form a three carbon compound with the release of one umole of CO_2.

$$2\ CHO\text{-}COO^- \rightarrow (CHO\text{-}CHOH\text{-}COO^- \rightleftarrows CH_2OH\text{-}CO\text{-}COO^-) + CO_2$$

The thiamine pyrophosphate and Mg^{++} requirements shown by partially purified fractions are characteristic for such condensation reactions.

An ammonium sulfate fraction from extracts of parsley specifically reduces hydroxypyruvate to D-glyceric acid.[3,4] When the end product of the reaction which utilized glyoxylate is incubated with DPNH and parsley enzyme, oxidation of DPNH occurs slowly and only after twenty minutes. Similarly, synthetic hydroxypyruvate is only slowly reduced by DPNH in the presence of the crude extract from glycollate-grown Escherichia coli. The end product of both reduction reactions are alike chromatographically.

Enolization of hydroxypyruvate to tartronic semialdehyde is known to take place in basic solutions.[5] These findings are consistent with the formulation that the initial product of the glyoxylate utilizing reaction is tartronic semialdehyde and that this enolizes slowly to form hydroxypyruvate. When this reaction product is incubated with D-glyceric dehydrogenase from parsley and DPNH, the slow oxidation of the latter may be ascribed to the slow formation of hydroxypyruvate. Since DPNH is quickly oxidized when added to crude coli extract which has been previously incubated with glyoxylate, the dehydrogenase in coli extract appears to be specific for tartronic semialdehyde.

Extracts of glycollate-adapted cells also reduce glyoxylate rapidly in the presence of DPNH.

Tracer experiments with 2-C^{14}-glycollate from which aliquots have been removed at short time intervals, show that the three carbon compound formed from glyoxylate is used in the synthesis of other, as yet unidentified, compounds.

From the reactions known to occur in E. coli and from those shown to occur in glycollate-adapted cells, one could construct a pathway which might account for the growth of the organism on glycollic acid.

glycollate
↓
glyoxylate
↓
CO_2 + tartronic semialdehyde ⇌ hydroxypyruvate
↓
glyceric acid
↓
phosphoglyceric acid
↓
phosphoglyceraldehyde ⇌ carbohydrate

Microfilm $2.50; Xerox $3.00. 60 pages.

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CAROTENE SYNTHESIS FROM CARBON-14 PRECURSORS BY NEUROSPORA CRASSA

(L. C. Card No. Mic 59-6488)

Leo Francis Krzeminski, Ph.D.
Purdue University, 1959

Major Professor: F. W. Quackenbush

The work is a study of carotene biosynthesis in Neurospora crassa (a cross of wild types E 5297a and E 5256A) which was selected from a survey of 24 strains of highly colored fungi. Of those fungi studied, another fungus Penicillium sclerotiorum was found to contain two major pigments, all trans β-carotene and all trans γ-carotene.

Cultivation of Neurospora crassa by 5 methods was studied and a submerged culturing method was developed for a reciprocating shaker. Submerged cultures of Neurospora crassa, grown in a medium containing polyoxyethylene sorbitan monopalmitate (Tween 40) on a shaker, gave uniformly pigmented mycelia in approximately 5½ days. Stimulation of carotene synthesis by Tween 40 was maximal at 0.8%. The minimum amount of Tween 40 for good dispersion of the mats was 0.4%. Twelve surface active agents were studied and it was found that only polyoxyethylene sorbitan monolaurate, monopalmitate, monostearate, and monooleate (Tweens 20, 40, 60, & 80; respectively) prevented the aggregation of the hyphae into lumpy masses commonly found with submerged cultures grown on a shaker. Some of the other surface active agents were quite stimulatory to carotene synthesis at lower concentrations than the Tweens, but did not effect good submersion and dispersion of the mycelium. Increased carotene synthesis was obtained with 0.6% ammonium nitrate, a carbon/nitrogen ratio (C/N) of 4.

Addition of metabolic compounds to the medium of Neurospora crassa gave only slight stimulation of carotene synthesis and in some cases repressed its formation. Culturing of Neurospora crassa on various compounds as the sole carbon source in most cases gave poor growth or none at all.

Experiments using 2-C^{14}-sodium acetate in Neurospora crassa grown by the submerged culturing technique showed: (1), that it was not a good precursor of carotenes and (2), that the crude carotene fraction from Neurospora crassa was grossly contaminated with esterified sterols and fatty acids.

A comparative study of eight C^{14}-labeled compounds showed that 2-C^{14}-mevalonic acid was the best utilized by 2 day old cultures of Neurospora crassa. Incorporation of the N,N'-dibenzylethylene-diammonium salt was 5 times better than the sodium salt or the free acid.

Rate studies, using the 2-C^{14}-mevalonic acid as the

diammonium salt, showed that the activity in the total carotene fraction dropped after the fungus was transferred from labeled to non-labeled medium. Separation of the individual pigments showed that there was no general sequential synthesis from the saturated carotenes to the unsaturated, neither is the reverse true. The activity of γ-carotene and its isomers showed the greatest increase while phytoene showed the greatest loss. Activity of those carotenes more saturated than lycopene decreased by 50% at a time when the level of all carotenes increased. A stepwise mechanism was suggested among only a certain few pigments.

Fatty acids in the crude carotene fraction from Neurospora crassa were analyzed by paper and gas chromatography and the following acids were shown to be present: linoleic, oleic, stearic, palmitic, and palmitoleic.

Microfilm $2.50; Xerox $4.60. 88 pages.

ION-EXCHANGE CHROMATOGRAPHY AND ERYTHROCYTE NUCLEOTIDES

(L. C. Card No. Mic 59-4199)

James Edward Muldrey, Jr., Ph.D.
Tulane University, 1959

Chairman: William B. Wendel

A new graphic method of processing chromatographic data has been described in which concentrations of eluate from chromatographic columns are plotted on probability paper with a linear abscissa axis. On the ordinate axis is plotted either percentage of each substance eluted or concentration expressed as percentage of the concentration of the peak fraction (computed from Gaussian error curve tables). With volume of eluate as abscissa, a series of straight lines replaces the conventional succession of peaks. Overlap of two adjacent straight lines permits computation of the degree of cross-contamination or purity of each fraction. "Normalization" of the plot of a single substance may be obtained by using the above ordinate scale and the ratio of eluent volume to volume-at-peak on the abscissa. This "normalized" plot facilitates approximation of the number of plates in a given column run, or, conversely, permits prediction of column operation for a desired number of plates in an elution at constant ionic strength. Thus, one may conveniently calculate the column length necessary to effect a desired separation. Attention has been directed to the applicability of these graphic methods to any countercurrent process.

A convenient method of using the linear gradient elution equations of Schwab, et al. (56) has been suggested for the prediction of peak location in exponential gradient elutions, but the validity of the simplifying assumptions remains to be established.

Elutions of DPN and TPN from quaternary anion exchange resins at constant ionic strength confirmed Cohn's (45) suggestion that the volume to a nucleotide peak at a given pH is inversely related to anion concentration.

Nucleotides and other acid-soluble metabolites were extracted from erythrocytes by TCA and PCA. These extracts were chromatographed on anion exchange resin columns by a modification of Cohn's technique, by Bartlett's (8) procedure and by Hurlbert's (52) extended gradient elution with formic acid and ammonium formate. Eluent fractions containing nucleotide peaks were lyophilized, rechromatographed and their nucleotides identified by phosphate and ribose determinations, ultraviolet absorbancy, paper chromatography and other appropriate methods.

Concentrations of AMP, ADP, ATP, DPN and TPN were found to confirm previously reported values for erythrocytes from normal and anemic blood. The presence of the heretofore unreported nucleotides UDPH and GTP was observed in all blood extracts which were examined by Hurlbert's technique. Subsequent to the identification by the present writer of UMP, IMP and GMP in blood extracts, Vanderheiden and Huennekens (93) have reported finding these nucleotides in red cell extracts. The obvious function of UDPH in red cell galactose metabolism was suggested, but the role of IMP and the guanylic nucleotides in red cells remains obscure.

No significant qualitative or quantitative difference was found between the nucleotides extracted from the relatively young and old erythrocytes which were obtained from the top and bottom layers of centrifuged sickle cell blood.

Microfilm $2.50; Xerox $6.60. 139 pages.

STUDIES ON THE CONTROL OF PROTEIN SYNTHESIS IN NORMAL AND NEOPLASTIC RAT LIVER

(L. C. Card No. Mic 59-4201)

Henry Clement Pitot III, M.D., Ph.D.
Tulane University, 1959

Chairman: Dean D. Watt

Several aspects of the control of protein synthesis have been studied in the normal and neoplastic rat liver.

The substrate induction of tryptophan peroxidase in primary and transplanted hepatomas was attempted in vivo and in vitro. Although the non-neoplastic liver responded to excess tryptophan by a significant increase in tryptophan peroxidase activity, the hepatomas showed no change in their low level of the enzyme both in vivo and in vitro. The substrate induction of proline oxidase and of histidase in rat liver was attempted by the injection of L-proline and L-histidine, but proved to be unsuccessful. A new enzymatic property of rat liver, the deamination of ethanolamine phosphate, has been found. Several properties of the enzymatic reaction have been presented and discussed. The activities of eight enzymes including reduced triphosphopyridine nucleotide cytochrome c reductase, choline oxidase, glutamic dehydrogenase and fructose 1,6 diphosphatase have been studied in rat liver and the transplantable Novikoff and Dunning LC 18 hepatoma. All of these enzymes showed measurable activity in the Dunning hepatoma LC 18 and normal liver, but only one of these enzymes, reduced diphosphopyridine nucleotide cytochrome c reductase, was found in significant amounts in the Novikoff hepatoma.

The effect of starvation and of feeding diets containing different amounts of protein on the activities of threonine and of serine dehydrase, tryptophan peroxidase and histidase in rat liver was studied. The activities of all these

enzymes except histidase increased significantly after five days of starvation. This effect was not abolished by adrenalectomy. A similar increase in tryptophan peroxidase and the dehydrase activities was found to occur as the protein of the diet was increased.

Several cell-free systems from rat liver capable of effecting a net increase in protein-like material upon incubation have been described. One system employing Fe^{++} and orthophosphate, together with an adenosine triphosphate-generating system and microsomes and supernatant was capable of effecting a net increase in acid precipitable nitrogen, a net increase in immunologically available albumin and the incorporation of labeled phenylalanine and methionine. Microfilm $2.60; Xerox $9.00. 199 pages.

STUDIES ON CARBOXYPEPTIDASE

(L. C. Card No. Mic 59-5474)

John Allen Rupley, Ph.D.
University of Washington, 1959

Carboxypeptidase, as isolated from beef pancreas glands, contains 1 gm. atom of zinc per mole of protein. Pancreatic juice was labelled with Zn^{65} in vivo by administration of radioisotope to a steer or dog having a pancreatic fistula. Crystalline bovine and canine carboxypeptidase containing Zn^{65} was isolated from the pancreatic juice so obtained. The zinc in the bovine protein was removed by dialysis against buffers of low pH or against buffers containing 1,10-phenanthroline. A concomitant loss of enzymatic activity was observed, clearly indicating the functional role of the zinc as part of the enzymatic site. However, activity was restored to the metal-free protein by a variety of metals besides zinc. Thus carboxypeptidase exhibits those properties of both metalloproteins and metal-protein complexes which favor most experimental study, namely, a strong, but reversible, association with metals. Study of this enzyme may therefore be especially fruitful in leading to information on the manner in which the metal participates in the enzymatic activity and in the structure of the protein. Towards this end a comparison was undertaken of several physical properties of the metal-free and native proteins. It was observed that removal of the metal produced no gross configurational changes in the protein. However, removal of the metal reduced the stability of carboxypeptidase at alkaline pH.

Microfilm $2.50; Xerox $5.80. 118 pages.

PART I. STUDIES ON THE NUTRITION OF DROSOPHILA MELANOGASTER LARVAE. PART II. STUDIES ON THE INHIBITION OF YEAST BY p-AMINOBENZOIC ACID.

(L. C. Card No. Mic 59-6737)

Alfred Christian Schram, Ph.D.
The University of Texas, 1958

Supervisor: L. J. Reed

PART I.

The purpose of the investigation was to prepare a chemically defined medium which would support normal development of Drosophila melanogaster. Yeast extract, which was a necessary supplement to a two per cent casein diet for normal development, was fractionated to obtain a factor that stimulated larval growth. The factor was isolated and identified as glycine. Yeast extract can be replaced to a major extent by a combination of glycine and arginine. The latter compound had been isolated previously and shown to be one of the growth stimulatory factors present in yeast extract.

A chemically defined medium was devised, in which casein was replaced by an equivalent mixture of amino acids. The average larval development time on this medium was 6 to 6.5 days. This value compares favorably with that obtained on the two per cent casein medium supplemented with yeast extract (approximately 5 days). Other chemically defined media reported in the literature permit larval development in 6.5 to 10.9 days.

The chemically defined medium apparently furnishes all of the nutrients essential for the development of the organism, since flies have been reared on this medium under aseptic conditions for at least four generations. As the growth rate and development can be improved somewhat by addition of yeast extract, it appears that the balance of nutrients is not optimum in the chemically defined medium.

PART II.

The inhibition of Saccharomyces cerevisiae by high concentrations of p-aminobenzoic acid (PABA) was reversed by an acid hydrolysate of liver residue. The active principle(s) was concentrated approximately 165-fold and tentatively identified as a peptide (or a mixture of peptides).

Aromatic amino acids, in the order phenylalanine tyrosine tryptophan, reverse the inhibition of yeast by PABA. A combination of the three amino acids was more effective than the individual amino acids. These findings suggested that PABA inhibited the utilization of a common precursor of the aromatic amino acids. Support for this hypothesis was obtained by demonstrating that shikimic acid accumulated in the medium when yeast was grown in the presence of PABA. Since added shikimic acid does not reverse PABA inhibition of yeast, it would appear that exogenous shikimic acid is inaccessible to its enzyme within the cell.

The site of PABA inhibition in yeast is apparently different from that in Escherichia coli, since with E. coli the inhibition is reversed competitively by p-hydroxybenzoic acid and to a limited extent by shikimic acid or 5-dehydroshikimic acid, whereas with yeast the latter three substances are ineffective in reversing PABA inhibition.

Microfilm $2.50; Xerox $4.20. 80 pages.

AN INVESTIGATION OF VARIATIONS IN THE CONCENTRATIONS OF LACTOSE, CHLORIDE, SODIUM, AND POTASSIUM IN "NORMAL" AND "ABNORMAL" MILK OF INDIVIDUAL COWS.

(L. C. Card No. Mic 59-6641)

William James Leonard Sutton, Ph.D.
The Ohio State University, 1954

A review of the pertinent literature indicates that there have been several studies of the variations in the chloride concentration of milk. The use of a high chloride concentration as compared with some arbitrary "normal" level has not been found entirely satisfactory as a criterion of "abnormal" milk composition. Few investigations considered the simultaneous variations of the concentrations of a number of milk components in individual udder quarters.

The variation of lactose and chloride concentrations of milk appears to be a reciprocal one, in maintaining the normal isotonicity of milk. Udder infections may result in a decrease in lactose concentration and an increase in chloride ion concentration, resulting in milk of "abnormal" composition.

Previous investigations of variations in concentrations of certain milk components, which resulted in quantitative relationships, include equations relating lactose and chloride, the chloride-lactose ratio (Koestler number), and correlations between two components.[1,2]

The derivation of characteristic constants for individual animals from the concentrations of "osmotically active" milk components has received little attention. Little data is available on the composition of milk from individual udder quarters of the same animal, and in particular for sodium and potassium concentrations. The relationship between udder infections and milk of "normal" or "abnormal" composition has not been clearly established.

The present investigation is limited to determinations of the concentrations of lactose, chloride, sodium, and potassium in individual udder quarter foremilk samples of a group of animals which have an extensive previous history of udder infections. This data on the principle water soluble components of milk is used to derive (1) characteristic normal values for each udder quarter of individual animals, and (2) certain fundamental relationships involved in the variations of these milk constituents.

The Lactose-Chloride Relationship in Milk

Lactose and chloride concentrations were determined in 112 foremilk samples taken from nine animals. Only three samples were of abnormal appearance. The percentage lactose for all samples ranged from 1.82 to 4.94, and that for chloride from 0.075 to 0.267. The lactose and chloride concentrations of each foremilk sample were used to derive the "lactose-chloride" and "chlorolac" values. The lactose-chloride value is defined as "the sum of the number of millimoles of lactose and milliequivalents of chloride ion in 100 grams of milk," and the chlorolac value as "the sum of the number of millimoles of lactose and twice the number of milliequivalents of chloride ion in 100 grams of milk." The former is an index of the osmotic pressure of milk due to lactose molecules and chloride ions, the latter an index of the osmotic pressure due to lactose molecules, chloride ions, and the cations associated with the chloride ions.

These lactose-chloride and chlorolac values were used as a basis for comparing the composition of the four foremilks of each udder at each milking. Any foremilk having a lactose-chloride or a chlorolac value which diverged markedly from those for the other udder quarters of the same animal was considered to have an "abnormal" composition. Thus on the basis of agreement of chlorolac values for the four foremilks, 93 foremilks out of 109 "normal appearing" samples were considered to have a "normal" composition. Foremilk samples from infected udder quarters gave lactose-chloride and chlorolac values which differed markedly from the corresponding values for the other udder quarters of the same animal. The average lactose-chloride and average chlorolac values for each udder quarter were calculated from the corresponding values for "normal" foremilk samples. These average values are presented in Table I and Table II.

TABLE I

Lactose-Chloride Values of Foremilk of Individual Quarters

Animal No.	Left Front	Left Rear	Right Front	Right Rear	Average of Four Quarters
541 H	16.1	15.9	16.2	16.3	16.1
438 H	----	15.9	16.1	16.0	16.0
510 H	16.1	15.8	15.8	16.3	16.0
410 H	16.0	15.8	15.9	15.9	15.9
338 G	----	15.7	15.6	15.8	15.7
519 H	15.7	15.4	15.9	15.7	15.7
525 H	15.3	15.1	15.6	15.3	15.3
443 H	15.1	14.9	15.3	15.3	15.2
530 G	15.0	15.1	14.9	15.1	15.0

The lactose-chloride and chlorolac values appear to be characteristic for all four quarters of each animal. The four foremilk samples of an individual udder may show considerable differences in lactose and chloride concentrations at any given milking, but the four lactose-chloride values and the four chlorolac values generally show very close agreement.

TABLE II

Chlorolac Values of Foremilk of Individual Quarters

Animal No.	Left Front	Left Rear	Right Front	Right Rear	Average of Four Quarters
438 H	20.1	20.2	20.2	20.1	20.2
541 H	20.0	19.9	19.9	20.0	20.0
510 H	19.9	20.1	20.0	20.0	20.0
443 H	19.3	19.5	19.5	19.5	19.5
519 H	18.9	19.1	19.1	19.2	19.1
525 H	19.2	18.9	18.8	18.6	18.9
410 H	18.5	18.9	18.6	18.7	18.7
338 G	18.6	18.6	18.6	18.6	18.6
350 G	17.7	17.3	17.4	17.4	17.5

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The Lactose-Sodium Relationship in Milk

Lactose, sodium, and potassium concentrations were determined in 72 foremilk samples taken from six animals. Analytical values were used to calculate "lactose-sodium" and "sodalac" values for each foremilk sample. The lactose-sodium value is defined as "the sum of the number of millimoles of lactose and milliequivalents of sodium ion in 100 grams of milk." The sodalac value is defined as "the sum of the number of millimoles of lactose and twice the number of milliequivalents of sodium ion in 100 grams of milk." Average lactose-sodium and average sodalac values were calculated for each udder quarter from "normal" values, as indicated above for lactose-chloride and chlorolac values. These average lactose-sodium and sodalac values are presented in Table III and Table IV.

TABLE III

Lactose-Sodium Values of Foremilk of Individual Quarters

Animal No.	Lactose-Sodium				Average
	Left Front	Left Rear	Right Front	Right Rear	
510 H	15.5	15.3	15.4	15.4	15.4
350 G	15.2	15.2	15.4	15.2	15.3
338 G	15.3	15.3	15.2	15.1	15.2
410 H	15.0	15.1	15.2	15.1	15.1
438 H	15.0	----	15.1	15.1	15.1
525 H	14.5	14.4	14.7	14.5	14.5

TABLE IV

Sodalac Values of Foremilk of Individual Quarters

Animal No.	Sodalac Value				Average
	Left Front	Left Rear	Right Front	Right Rear	
510 H	18.7	18.6	18.6	18.8	18.7
410 H	18.5	18.4	18.8	18.3	18.5
350 G	18.0	17.8	18.0	17.8	17.9
338 G	17.6	18.3	17.4	17.4	17.7
438 H	16.9	----	17.2	17.1	17.1
525 H	16.3	16.3	16.8	16.9	16.6

The lactose-chloride value and sodalac value appear to be characteristic physico-chemical constants for each animal. Foremilk samples were considered to be of "abnormal" composition, based on a comparison of the four lactose-sodium or four sodalac values of each udder at each milking.

Interrelationship of Lactose, Chloride, Sodium and Potassium Contents of Milk

The experimental data was subjected to statistical treatment. A summary of the statistical data is presented in Table V.

TABLE V

Summary of Statistical Data

Milk Components	Slope of Regression Line*	Correlation Coefficients (a)	(b)**
1. Chloride-lactose	-0.46	-0.86	-0.70
2. Sodium-lactose	-0.79	-0.87	-0.50
3. Potassium-lactose	+0.24	+0.20	+0.18
4. Sodium-potassium	-1.35	-0.26	-0.24

*Milliequivalents of given ion per millimole of lactose, and milliequivalents sodium per milliequivalent of potassium in Number 4. Regression lines determined by method of least squares.

Regression Equations

$$Cl = 0.313 - 0.0454L \quad \text{----- (1)}$$
$$L = 6.89 - 22.0\ Cl \quad \text{----- (2)}$$

$$Na = 0.286 - 0.05061 \quad \text{----- (3)}$$
$$L = 5.65 - 19.8\ Na \quad \text{----- (4)}$$

Regression equations (1), (2) were obtained from 112 samples. Equations (3), (4) were obtained from 72 samples. All values in regression equations are given as grams per 100 grams whole milk.

**See Black and Voris[2]—134 samples.

This data indicates an unusually high degree of correlation for sodium and lactose, and for chloride and lactose. Correlations between potassium and lactose, and between sodium and potassium were extremely low. A derived relationship, computed from the slopes of the regression lines for the chloride-lactose, sodium-lactose, and potassium-lactose relations, apparently indicates that variations in the concentrations of these milk components tend to conform to that in which an interchange of one millimole of lactose occurs with a total of one milliequivalent of "alkali" chloride ions to maintain the normal isotonicity of milk. Microfilm $2.50; Xerox $4.60. 89 pages.

1. Barry, J. M., and Rowland, S. J. "Variations in the Ionic and Lactose Concentrations of Milk," Biochem. J., 54 (1953), pp. 575-78.

2. Black, A., and Voris, L., "A Statistical Study of the Relationships Between the Constituents of Milk," J. Agr. Res., 48 (1934), pp. 1025-41.

Abstract published by special arrangement with The Ohio State University.

IN VITRO INCORPORATION OF FORMATE INTO NUCLEIC ACID DERIVATIVES OF NORMAL AND LEUKEMIC HUMAN LEUKOCYTES

(L. C. Card No. Mic 59-6828)

Warren Wells, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

The in vitro incorporation of formate-C^{14} into nucleic acid derivatives and serine of normal and leukemic human leukocytes was studied using cells isolated from the blood of normal individuals and of patients with chronic lymphocytic or chronic granulocytic leukemia. The incorporation of other C^{14}-labeled precursors was investigated in certain aspects of these studies, as was the effect of amethopterin on formate incorporation.

The cells were suspended in a medium of normal human serum supplemented with glucose and were incubated with isotope for 4 hours at 37° C in an atmosphere of 95 per cent O_2 - 5 per cent CO_2. Following incubation the cells were washed with isotonic saline and were then sequentially extracted with cold 5 per cent trichloroacetic acid, alcohol-ether, and ether to yield a protein fraction free of acid-soluble and lipid components. The acid-soluble fraction, and the RNA and DNA fractions isolated from the protein fraction were hydrolyzed and the resulting purine and pyrimidine bases and serine were isolated by either ion-exchange or paper chromatography. The isolated compounds were quantitated, their radioactivities determined, and their specific activities calculated.

Acid-soluble and RNA purines and protein-bound serine of chronic lymphocytic leukemia cells showed a significantly higher incorporation of this isotope than did the corresponding components of normal leukocytes. Very little incorporation was noted in any of the DNA components of either of these cell types. Incorporation into acid-soluble and RNA purines and protein-bound serine of chronic granulocytic leukemia and normal leukocytes was comparable, while incorporation into DNA purines of these leukemic cells, though quite low, was significantly higher than into these components of normal cells. There was extensive incorporation of formate into DNA thymine of chronic granulocytic cells.

DNA of normal and chronic lymphocytic leukemia cells appeared to be quite metabolically inactive with respect to incorporation of radioactive formate and radioactive purine bases into DNA purines and thymine. DNA of chronic granulocytic leukemia cells appeared, contrarily, to be relatively active by these criteria. A marked difference was observed between formate incorporation into the DNA thymine and the DNA purines of these latter cells, which could be explained on the basis of differences in pool size and/or in metabolic activity between the acid-soluble precursors of these DNA components.

Amethopterin was found to inhibit the in vitro incorporation of formate into acid-soluble and RNA purines and protein-bound serine of chronic granulocytic leukemia cells by 50-70 per cent, and inhibited incorporation into DNA thymine of these cells by 98-99 per cent. Incorporation of formate into cellular components of normal and chronic lymphocytic leukemia cells was found to be either uneffected or stimulated by this drug.

The differential effect of amethopterin observed at the molecular level with chronic granulocytic leukemia cells suggested that this drug might have a site of action in thymine metabolism in addition to that in purine and serine metabolism. The most likely location for this additional site, if one exists, would be the final reduction of a one-carbon unit to form the methyl group of thymine.

Microfilm $2.50; Xerox $5.40. 107 pages.

MECHANISM OF PROTEIN HYDROLYSIS BY ION-EXCHANGE RESINS

(L. C. Card No. Mic 59-6657)

John Robert Whitaker, Ph.D.
The Ohio State University, 1954

A number of resins were tested for their ability to hydrolyze glycylglycine at 104.0°C. Dowex-50, a polystyrenesulfonic acid resin, is superior to the other resins tested for the hydrolysis of glycylglycine. The order of decreasing rate of hydrolysis was found to be: Dowex-50, Nalcite-HCR, Dowex-50-NO_2, Zeo-Rex, Dowex-50-NH_2, Amberlite IR-105, Dowex-30, Amberlite IRC-50, and Nalcite-SAR. The initial rate of hydrolysis of glycylglycine with Dowex-50-NO_2 was much faster than with Dowex-50, but it soon slowed down. The carboxylic acid resin, Amberlite IRC-50 and the strongly basic polyamine resin, Nalcite-SAR, do not hydrolyze glycylglycine at 104.0°C. The pH of the hydrolysates containing the phenol sulfonic acid resins was lower than the pH of the hydrolysates containing the sulfonic acid resins, but this difference in pH is not sufficient to account for the greater efficiency of the sulfonic acid resins.

The concentration of the substrate has an effect on the rate of hydrolysis. At low ratios of substrate to resin the hydrolysis of gelatin and glycylglycine are first order with respect to substrate concentration. At higher ratios of substrate to resin the hydrolysis is zero order with respect to substrate concentration, and at high ratios the velocity of hydrolysis is decreased due to inhibition by the substrate. A plot of substrate concentration versus the velocity of hydrolysis gives the same type of curve as is obtained in enzymatic reactions.

The formation of the resin-substrate complex is treated mathematically. A reproducible dissociation constant for the resin-substrate complex can be calculated from the equation

$$\frac{1}{v} = \frac{K_r}{V}\frac{1}{(S)} + \frac{1}{V} \qquad (1)$$

where v is the observed velocity of hydrolysis
V is the maximum velocity of hydrolysis
(S) is the substrate concentration and
K_r is the dissociation constant of the resin-substrate complex

This equation was derived in analogy with the treatment of Michaelis and Menten.[1] The development of equation (1) involves the assumption that there is no inhibition by the products of hydrolysis or by the substrate, which is true only at low substrate concentrations and during the initial phase of hydrolysis.

The dissociation constant, K_r, and the maximum

velocity, V, were determined for gelatin and glycylglycine according to equation (1) in the absence and presence of 0.0500 N hydrochloric acid. K_r, in the absence and presence of 0.0500 N hydrochloric acid, was found to be 12.0 grams per liter and 8.68 grams per liter respectively for the gelatin-resin complex measured after 1.38 hours of hydrolysis at 103.0°C. The maximum velocity, V, calculated for gelatin in the absence and presence of 0.0500 N hydrochloric acid was found to be 37.1 milliliters per 1.38 hours and 21.0 milliliters per 1.38 hours respectively. The values calculated for the glycylglycine-resin complex after 0.217 hours of hydrolysis at 104.0°C. were: in the absence of 0.0500 N hydrochloric acid, $K_r = 4.07 \times 10^{-2}$ moles per liter and V = 18.3 milliliters per 0.217 hours; and in the presence of 0.0500 N hydrochloric acid, $K_r = 7.59 \times 10^{-2}$ moles per liter and V = 14.5 milliliters per 0.217 hours.

The dissociation constant of the resin-substrate complex is dependent on the nature of the substrate, temperature, pH of the medium, and the presence or absence of inhibitory substances. Dowex-50 has a greater affinity for glycylglycine than for glycine. Glycylglycine is more acidic than glycine, and at a given pH more of the amino groups of glycylglycine would be uncharged than those of glycine. It appears that the uncharged amino group is the one that combines with the resin. An increase in temperature increases the dissociation constant. The heat of formation of the complex between the resin and the α-amino group is -1864 cal calculated from data on the adsorption of glycine on Dowex-50. A decrease in the pH of the medium increases the dissociation constant. The addition of 0.0500 N hydrochloric acid rather than distilled water as the solvent markedly decreased the rate of hydrolysis of gelatin and glycylglycine with Dowex-50. A decrease in pH was also found to produce a decrease in the adsorption of glycine on Dowex-50. It is postulated that the acid interferes with the formation of the resin-substrate complex. The addition of glycine, lysine·HCl or sodium chloride to the medium decreased the rate of hydrolysis of gelatin with Dowex-50.

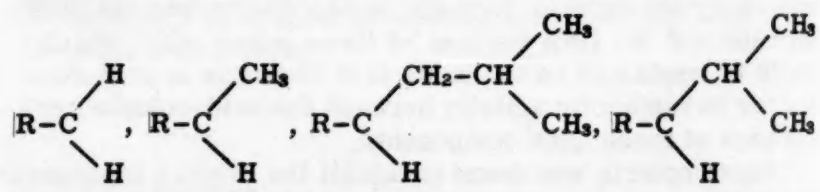
The rate of hydrolysis of several proteins by Dowex-50 at 104.0°C. decreases in the order: gelatin, edestin, bovine serum albumin, casein, and ovalbumin; with 1.081 N hydrochloric acid at 104.0°C. the rate decreases in the order: gelatin, edestin, casein, bovine serum albumin, and ovalbumin. The initial rate of hydrolysis is much slower with Dowex-50 than with 1.081 N hydrochloric acid, but as the amount of hydrolysis increases the rate of hydrolysis with Dowex-50 becomes faster than with 1.081 N hydrochloric acid. The hydrolysis of casein, bovine serum albumin, and ovalbumin with Dowex-50 appears to proceed in a stepwise fashion. Dowex-50 shows greater specificity in the hydrolysis of the proteins than does 1.081 N hydrochloric acid.

The kinetics of the hydrolyses by 1.081 N hydrochloric acid and by Dowex-50 of glycylglycine, DL-alanylglycine, glycyl-L-leucine, glycyl-DL-valine, DL-leucylglycine, DL-alanyl-DL-aspartic acid, prolyl-L-tyrosine, and DL-valyl-DL-isoleucine were studied at 104.0°C. With the exception of the hydrolysis of glycyl-DL-valine with Dowex-50, the rates of hydrolysis of the dipeptides conform to the first order rate equation

$$K^t = \frac{1}{(H^+)} \ln \frac{a}{a-x} \qquad (2)$$

The rate constants expressed in liter $mole^{-1}$ $hr.^{-1}$, calculated for hydrolysis by Dowex-50 and 1.081 N hydrochloric acid respectively are: glycylglycine, 45.1 ± 0.8 and 0.401 ± 0.006; DL-alanylglycine, 27.7 ± 0.6 and 0.248 ± 0.004; DL-alanyl-DL-aspartic acid, 27.1 ± 0.6 and 0.861 ± 0.008; glycyl-L-leucine, 22.3 ± 0.5 and 0.191 ± 0.006; glycyl-DL-valine, 24.5 ± 1.0 calculated from the second order rate equation times 100 and 0.136 ± 0.003; DL-leucylglycine, 10.1 ± 0.3 and 0.0868 ± 0.0010; prolyl-L-tyrosine, 1.80 ± 0.03 and 0.0466 ± 0.0015; and DL-valyl-DL-isoleucine, 0.386 ± 0.028 and 0.00363 ± 0.00014. The half-lives, expressed in hours, for hydrolysis by Dowex-50 and 1.081 N hydrochloric acid respectively are: glycylglycine, 0.242 and 1.60; DL-alanylglycine, 0.394 and 2.59; DL-alanyl-DL-aspartic acid, 0.402 and 0.745; glycyl-L-leucine, 0.489 and 3.36; glycyl-DL-valine, 0.642 and 4.71; DL-leucylglycine, 1.08 and 7.39; prolyl-L-tyrosine, 6.06 and 13.8; and DL-valyl-DL-isoleucine, 28.2 and 177. The relative rates of hydrolysis, expressed as the ratio of the rate constant for hydrolysis with Dowex-50 to the rate constant for hydrolysis with an equivalent amount of hydrochloric acid, are: glycylglycine, 112; DL-alanylglycine, 112; DL-alanyl-DL-aspartic acid, 31.5; glycyl-L-leucine, 117; glycyl-DL-valine, 126; DL-leucylglycine, 116; prolyl-L-tyrosine, 38.6; and DL-valyl-DL-isoleucine, 106. The relative rates of hydrolysis of the other dipeptides compared with the rate of hydrolysis of glycylglycine by Dowex-50 and 1.081 N hydrochloric acid respectively are: glycylglycine, 1 and 1; DL-alanylglycine, 0.614 and 0.618; DL-alanyl-DL-aspartic acid, 0.601 and 2.15; glycyl-L-leucine, 0.494 and 0.476; glycyl-DL-valine, 0.376 and 0.339; DL-leucylglycine, 0.224 and 0.216; prolyl-L-tyrosine, 0.040 and 0.116; and DL-valyl-DL-isoleucine, 0.0086 and 0.0091. Dowex-50 (equivalent to 0.0636 N acid) hydrolyzes the above dipeptides about 6.6 times as rapidly as 1.081 N hydrochloric acid. Exceptions to this are DL-alanyl-DL-aspartic acid and prolyl-L-tyrosine which are hydrolyzed about 2 times as rapidly by the resin as by 1.081 N hydrochloric acid. However, when the difference in the hydrogen ion concentration between the resin and acid are taken into consideration, Dowex-50 is found to be about 115 times as effective as an equivalent amount of hydrochloric acid. DL-alanyl-DL-aspartic acid and prolyl-L-tyrosine are again exceptions. The relative rates (compared with glycylglycine) for hydrolysis by acid and resin compare with the values reported by Synge.[2]

The effect of the carbon skeleton of the amino acid radical on the rate of hydrolysis of the dipeptides by hydrochloric acid and by Dowex-50 was found to increase in the order:



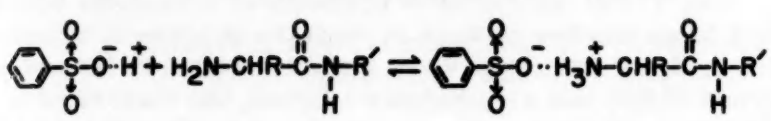
where R is the remainder of the dipeptide molecule. This is the same order reported by Levene, et al.[3]

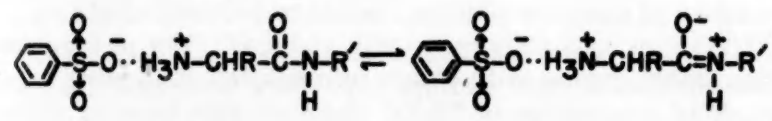
The kinetics of the hydrolyses by hydrochloric acid and Dowex-50 of acetylglycine, asparagine, acetamide, and ethyl acetate were studied at 104.0°C. The rate of splitting conforms to the first order rate law. The rate constants, expressed in liter $mole^{-1}$ $hr.^{-1}$, calculated for hydrolysis by Dowex-50 and hydrochloric acid respectively are:

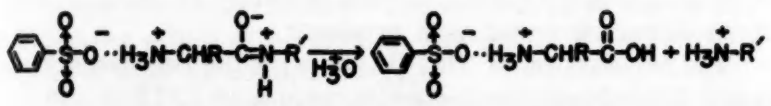
The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

acetylglycine, 1.37 ± 0.06 and 2.65 ± 0.05 for 1.081 N hydrochloric acid; asparagine, 111 ± 7 and 4.80 ± 0.10 for 0.0636 N hydrochloric acid; acetamide, 23.3 ± 1.4 and 41.5 ± 0.5 for 0.0636 N hydrochloric acid; and ethyl acetate 105 ± 6. The half-lives, expressed in hours, for hydrolysis by Dowex-50 and hydrochloric acid respectively are: acetylglycine, 8.26 and 0.242; asparagine, 0.0982 and 2.27; acetamide, 0.468 and 0.263; and ethyl acetate, 1.104. The relative rates of hydrolysis, expressed as the ratio of the rate constant for hydrolysis by Dowex-50 to the rate constant for hydrolysis by an equivalent amount of hydrochloric acid, are: acetylglycine, 0.498; asparagine, 231; and acetamide, 0.561. The relative rates of hydrolysis of these substances compared with the rate of hydrolysis of glycylglycine by Dowex-50 and hydrochloric acid respectively are: acetylglycine, 0.029 and 6.61; asparagine, 2.46; acetamide, 0.517; and ethyl acetate, 2.33. Acetylglycine is split 6.6 times as rapidly by 1.081 N hydrochloric acid as is glycylglycine. On the other hand, Dowex-50 splits glycylglycine 34.5 times as rapidly as it does acetylglycine. The effect of the presence of a free amino group on the rate of hydrolysis by Dowex-50 is shown.

A mechanism is proposed for the catalytic activity of Dowex-50. The sulfonic acid group of the resin combines with the uncharged amino group of the substrate to form the resin-substrate complex. The C-N linkage of the peptide bond becomes more susceptible to hydrolysis because of the loss of the stabilizing resonance of the molecule and the positive inductive effect of the sulfonic acid group of the resin molecule. The electronegativity of the oxygen atoms of the sulfonic acid group distorts the electronic configuration of the peptide bond in favor of the enol form. The equations for this proposed mechanism are:

1. 

2. 

3. 

The kinetics of the hydrolyses by Dowex-50 of glycylglycine, DL-alanylglycine, glycyl-L-leucine, glycyl-L-valine, and DL-leucylglycine were studied at 104.0°, 76.6°, and 57.9°C. The rate constants, expressed in liter mole^{-1} hr.$^{-1}$, for hydrolysis at 104.0°, 76.6°, and 57.9°C. respectively are: glycylglycine, 45.1 ± 0.8, 4.42 ± 0.10 and 0.635 ± 0.007; DL-alanylglycine, 27.7 ± 0.6, 2.75 ± 0.05, and 0.399 ± 0.012; glycyl-L-leucine, 22.3 ± 0.5, 2.57 ± 0.04, and 0.413 ± 0.002; glycyl-DL-valine, 24.5 ± 1.0 and 2.54 ± 0.11 (both these rate constants are calculated according to the second order rate equation times 100 and at 104.0° and 76.6°C.); and DL-leucylglycine, 10.1 ± 0.3, 0.919 ± 0.011 and 0.136 ± 0.010. The enthalpies of activation, ΔH^*, and entropies of activation, ΔS^*, were calculated by the least squares treatment of the data according to the equation

$$K = \left(\frac{kT}{h}\right) e^{\frac{\Delta S^*}{R}} e^{-\frac{\Delta H^*}{RT}} \qquad (3)$$

where K is the specific reaction rate constant, k is the Boltzmann constant, h is the Planck constant, T is the absolute temperature, R, is the gas constant, ΔS^* is the entropy of activation and ΔH^* is the enthalpy of activation. The free energies of activation, ΔF^*, were calculated from the equation

$$\Delta F^* = \Delta H^* - T\Delta S^* \qquad (4)$$

The values of ΔH^* (kcal mole^{-1}), ΔS^* (cal deg^{-1} mole^{-1}) and ΔF^* (kcal mole^{-1} at 104.0°C.) respectively are: glycylglycine, 22.2, -8.77, and 25.5; DL-alanylglycine, 22.1, -10.1, and 25.9; glycyl-L-leucine, 20.7, -14.1, and 26.0; glycyl-DL-valine, 21.0, -14.0, and 26.3; and DL-leucylglycine, 22.5, -11.1, and 26.7. The enthalpies of activation, ΔH^*, were found to be about the same as the ΔH^* for the acid catalyzed reactions.[4] However, there is a marked increase in the entropies of activation, ΔS^*, for the Dowex-50 catalyzed hydrolysis as compared with the acid catalyzed hydrolysis.[4] The free energies of activation, ΔF^*, are lower for the Dowex-50 catalyzed reaction than for the acid catalyzed reaction.[4]

The increased efficiency of Dowex-50 as compared with hydrochloric acid is due to an increase in the entropy of activation. Microfilm $2.50; Xerox $6.40. 132 pages.

1. Michaelis, L., and Menten, M. L. "Die Kinetik der Invertinwirkung." Biochem. Z., 49 (1913), pp. 333-69.

2. Synge, R. L. M. "The Kinetics of Low Temperature Acid Hydrolysis of Gramicidin and of some Related Dipeptides," Biochem. J., 39 (1945), pp. 351-5.

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4. Lawrence, L., and Moore, W. J. "Kinetics of the Hydrolysis of Simple Glycine Peptides," J. Am. Chem. Soc., 73 (1951), pp. 3973-77.

Abstract published by special arrangement with The Ohio State University.

THE EFFECT OF DIETARY MAGNESIUM, PHOSPHORUS, THIOURACIL, AND PROTEIN ON PLASMA CHOLESTEROL LEVELS.

(L. C. Card No. Mic 59-6524)

Vandon Ellaquient White, Ph.D.
Purdue University, 1959

Major Professor: Herbert E. Parker

Magnesium and phosphorus play a vital role in cholesterol metabolism and regulation. An experiment of factorial type design was conducted using 0.0 and 0.028 per cent added magnesium and 0.202 and 0.379 per cent phosphorus in the preparation of the diets. Two levels of fat were used in preparing these diets. The animals were maintained on the diets ad libitum for eight weeks. At the end of the experimental period the blood plasma was analyzed for magnesium, phosphorus, calcium, sodium, and cholesterol. Their thyroid, adrenal, thymus glands, liver, and kidney were removed and weighed.

Animals on diets deficient in magnesium developed

magnesium deficiency symptoms in two phases. The first phase consisted of hyperirritability, vasodilation, tetanic convulsions, and early death in some of the animals. In the second phase the animals exhibited poor growth and an inferior hair coat. The magnesium deficiency symptoms observed in the first phase were reduced in the second phase. Magnesium and phosphorus deficiencies caused increased plasma cholesterol levels. Animals on diets deficient in magnesium and phosphorus and high in fat had enlarged thyroids. The aorta weight of rats on high fat diets decreased when magnesium and phosphorus were added to the dietary regimen of these animals. Increasing the magnesium in the diets tended to decrease the sodium in the plasma. Animals receiving diets deficient in magnesium had low plasma magnesium concentrations. In animals on normal fat diets, increasing the magnesium or phosphorus beyond the normal levels tended to increase the plasma cholesterol concentration. It was found by determining fecal and urinary magnesium that phosphorus enhances the absorption of magnesium from the digestive tract.

Information was obtained from a study of the effect of thiouracil and magnesium on plasma cholesterol concentration. Both normal and high fat diets (also contained 2% added cholesterol) were used. All animals received 1 per cent sodium glycholate. At each of the two fat levels diets were made that contained 0.0 and 0.1 per cent thiouracil and 0.0, 0.028, and 0.056 per cent magnesium. These diets were used in an experiment of factorial type design. At the end of the experimental period, blood samples were taken by heart puncture and analyzed for magnesium and cholesterol. The thyroid glands were removed and weighed, and their iodine content determined.

Thiouracil reduced the plasma magnesium level to that of extreme magnesium deficiency regardless of the dietary level of magnesium. The determination of fecal and urinary magnesium showed that thiouracil tended to reduce the absorption of magnesium from the digestive tract and greatly increased the urinary excretion of ingested magnesium. Feeding thiouracil in the diets of rats caused retarded growth rates which could be partially overcome by adding magnesium to the diets. Animals receiving high levels of fat plus 0.1 per cent thiouracil were not greatly affected by magnesium additions to the diet. Rats on diets that were deficient in magnesium and contained high levels of fat and 0.1 per cent thiouracil had elevated plasma cholesterol levels. Magnesium deficiencies also decreased the iodine content of the thyroid glands.

A factorial type experiment was conducted to determine the effect of various dietary levels of protein on the plasma cholesterol concentration of rats on different levels of magnesium. Diets were used that contained 10, 20, and 40 per cent protein. The levels of magnesium added in preparing the diets were 0.0, 0.028, and 0.056 per cent. I^{131} was used to determine the effect of these diets on the iodine uptake and the conversion of iodine into thyroxine.

Magnesium deficiency tended to increase the size of the thyroid glands at all protein levels. Protein levels had little or no effect on thyroid size. Protein deficiency greatly reduced the uptake of I^{131} by the thyroid glands. At medium and high protein levels magnesium deficiency increased I^{131} uptake by the thyroid glands, but this was not true at the low protein level. Eighty to 99 per cent of the I^{131} in the thyroid glands was protein bound and no trends were apparent in the effect of protein or magnesium levels. The ratio of plasma PBI^{131} to total plasma I^{131} was much smaller at low than at medium or high protein levels. Rats on the lowest protein diet and the lowest magnesium level gained the least, had the largest thyroid weight per 100 grams of body weight, had the least I^{131} uptake by their thyroids, converted the least ^{131} into plasma PBI^{131}, and had the lowest ratio of plasma PBI^{131} to total plasma I^{131}.

Magnesium deficiency increased plasma cholesterol. Lower cholesterol levels were found in the plasma of animals on diets containing 0.056 per cent magnesium than were found in the plasma of animals receiving 0.028 per cent magnesium in the diet. At low magnesium levels, the protein concentration of the diet had no effect on the plasma cholesterol levels. At 0.028 and 0.056 per cent magnesium, raising the dietary protein level raises the plasma cholesterol concentration.

Microfilm $2.50; Xerox $4.40. 82 pages.

CHEMISTRY, INORGANIC

HYDROLYSIS AND OLATION OF Th(IV) CHELATES IN AQUEOUS SOLUTION

(L. C. Card No. Mic 59-6175)

Raymond Francis Bogucki, Ph.D.
Clark University, 1959

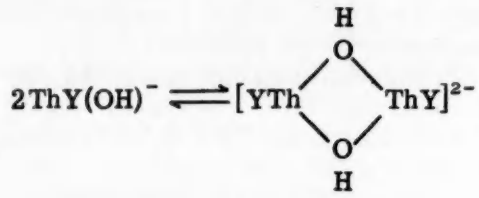
Supervisor: Arthur E. Martell

The Th(IV) ion can form polynuclear hydrolysis products in a large number of ways through the process of hydroxyl ion bridging (olation). When a stable chelate is formed between Th(IV) and a multidentate ligand, the number of hydrated coordination sites is greatly reduced, and hence the number of possible olation reactions between chelated Th(IV) ions will also be greatly reduced. The purpose of this investigation is to obtain information regarding the mode of interaction of Th(IV) chelates with base by means of potentiometric titrations, and possibly to identify some of the resultant hydrolysis products.

The interaction of Th(IV) ions with the octadentate ligands diethylenetriaminepentaacetic acid (DTPA) and [ethylenebis(oxyethylenenitrilo)]tetraacetic acid (EOTA) as well as with combinations of other ligands containing a total of eight donors, results in the formation of octacoordinated Th(IV) chelate compounds, stable in acidic or slightly acidic solution. At higher pH, most of these chelates form mononuclear monohydroxo chelate compounds with pK values in the pH range 7 - 9.

Th(IV) interacts with the heptadentate ligand [oxybis-(ethylenenitrilo)]tetraacetic acid (OETA) to produce a heptacoordinated chelate with a pK value of 6.35 involving the formation of a stable monohydroxo compound. In this case, evidence was not found for polynuclear hydroxo complex formation.

The hexacoordinated chelates of Th(IV) with ethylenediaminetetraacetic acid (EDTA) and cyclohexanediaminetetraacetic acid (CDTA) form monohydroxo compounds with pK values of 7.04 and 7.58 respectively. Both monohydroxo complexes readily form binuclear diolated chelate compounds according to the reaction



in which Y^{4-} would represent the tetranegative EDTA or CDTA anion, and for which the equilibrium constant has the value $10^{4.3}$ for both the EDTA and CDTA chelates. Other polynuclear forms are probably produced upon further hydrolysis.

Potentiometric titrations of the Th(IV) chelate of N-hydroxyethylethylenediaminetriacetic acid (HEDTA) indicate that this compound also forms binuclear, diolated chelate compounds. However, both potentiometric and ultracentrifugation measurements indicate that these forms rearrange upon further hydrolysis to a stable ternuclear hydroxo complex which contains $5OH^-$ ions for each three Th(IV)-HEDTA ions.

Spectrophotometric studies showed that the Th(IV)-HEDTA chelate has a formation constant equal to $10^{18.5}$. The 1:1:1 mixed chelate of Th(IV) with EDTA and 3,5-pyrocatecholdisulfonic acid (Tiron) has an overall formation constant of $10^{36.7}$, the highest value determined in this investigation. Microfilm $2.50; Xerox $3.80. 69 pages.

DEVELOPMENT OF ANALYTICAL METHODS FOR BORON AND BISMUTH

(L. C. Card No. Mic 59-6474)

Robert Henry Campbell, Ph.D.
Purdue University, 1959

Major Professor: M. G. Mellon

A sensitive absorptimetric method for the determination of bismuth was developed. The element can be determined in the range of 0.02 to 1.2 mg./50 ml. and the average molar absorptivity is 12,500. The method is based on the enhancement effect of bismuth on the reduction of molybdophosphoric acid by ascorbic acid.

Possible variables were studied to determine the optimum operating conditions. The method was tested by analyzing NBS standard samples. Some possible interferences were studied and tolerances determined.

Some ultraviolet, polarographic, and general chemical observations were made concerning the nature of the bismuth effect. A solid, mixed heteropoly acid of bismuth and molybdophosphoric acid could not be prepared by the technique used. The bismuth effect showed several catalytic characteristics and no interaction of bismuth and molybdophosphoric acid in solution was detected by the polarographic and ultraviolet techniques investigated.

A new indirect absorptimetric method for determining boron based on the fluoride complexes of molybdate and boric acid was developed. The presence of fluoride in sufficient quantities prevented the reduction of acidified molybdate solution by chlorostannous acid to form a blue hue. The addition of boric acid removed fluoride from the molybdate to form a blue hue. The method has a molar absorptivity of 7,000 and a determination range from 0.1 to 2.5 mg. of boron/50 ml. It is subject to interference from elements forming strong fluoride complexes or heteropoly acids.

The variables effecting the method were investigated and optimum working conditions determined.

In an effort to develop a procedure for boron, tungstoboric acid was investigated.

An improved method for the preparation of solid tungstoborate was developed. It is based on ether extraction of tungstoboric acid from acidic solution at temperatures below $-15^{\circ}C$.

Tungstoboric acid was reduced by chlorostannous acid to blue reduction products in 4 to 10 N acid. However, metatungstic acid reacted in the same manner.

Qualitative and quantitative analysis of the solid acid substantiated essentially the same composition as the literature values for tungstoboric acid. Sodium, potassium, and ammonium salts of tungstoboric acid were prepared. Their methods of preparation were described.

Microfilm $2.50; Xerox $7.60. 161 pages.

PROPERTIES AND REACTIONS OF SOLUTIONS OF IODINE IN LIQUID AMMONIA

(L. C. Card No. Mic 59-6735)

Donald Ray Foerster, Ph.D.
The University of Texas, 1958

Supervisor: George W. Watt

The properties and reactions of solutions of iodine in anhydrous liquid ammonia have been studied, since the earlier reports on this subject contained insufficient and inconclusive data. In some instances wholly new evidence is presented; in others, conclusive support is provided for conclusions reached previously from largely inadequate data.

The data for the reaction between iodine and liquid ammonia at room temperature are consistent with the equation

$$3I_2 + 8NH_3 \longrightarrow 6NH_4I + N_2$$

which was proposed earlier from very little experimental data.

It was found that when magnesium was placed in a liquid ammonia solution of iodine at -75° and then warmed to room temperature in a sealed tube, the ammoniated nitrogen triiodide (formed from the reaction between iodine and liquid ammonia below -33°) decomposed to ammonium iodide and nitrogen, after which the magnesium reacted with the ammonium iodide to form magnesium iodide hexammoniate and hydrogen. The attempt to prepare pure anhydrous magnesium iodide by the thermal deammoniation of magnesium iodide hexammoniate was unsuccessful.

Many reactions with anhydrous liquid ammonia solutions of iodine as well as with the isolated olive-green solid formed in these solutions have proved that the reaction between iodine and anhydrous liquid ammonia at temperatures below -33° can be represented by the equation

$$3I_2 + xNH_3 \rightleftharpoons NI_3 \cdot yNH_3 + 3NH_4I \cdot zNH_3$$

Earlier assumptions that liquid ammonia solutions of

iodine contain I^{n+} are apparently unfounded. Three distinctly different kinds of experimental evidence have been used to demonstrate the absence of such species.

A reddish black liquid which remained after a liquid ammonia solution of iodine had been evaporated was found to be a mixture of iodine, ammonium iodide, and ammonia. The evidence from various analyses of this red-black liquid supported the belief that the reaction between iodine and liquid ammonia at -33.4° is reversible.

Microfilm $2.50; Xerox $3.00. 59 pages.

POLYNUCLEAR CHELATES OF URANIUM AND THORIUM IN AQUEOUS SOLUTION

(L. C. Card No. Mic 59-6176)

Richard Lyman Gustafson, Ph.D.
Clark University, 1959

Supervisor: Arthur E. Martell

The interaction of uranyl ion with Tiron (pyrocatechol-3,5-disodium sulfonate) has been studied potentiometrically and spectrophotometrically in the pH range 2 - 11. Below pH 3.5 the solutions contain primarily 1:1 mononuclear chelate species although it appears that polymeric forms of the unhydrolyzed chelates may exist to some extent. Further reaction of the monomeric chelate with hydroxide ion results in hydrolysis and polymerization to a ternuclear species which is completely formed at pH 5.3. These reactions are independent of the amount of excess Tiron employed. Equilibrium constants have been calculated which describe the initial buffer region within approximately 0.03 pH units over a wide range of metal chelate concentration. Further interaction of Tiron with the ternuclear complex in the pH range 5.3 - 8.5 produces a chelate compound containing 2 1/3 moles of Tiron per gram-ion of UO_2(VI). General equations for deducing the formulas of polynuclear metal chelate species have been derived.

The hydrolytic behavior of the UO_2(VI) ion has been investigated in the pH range 2.5 - 5.5. Evidence for the existence of a mononuclear hydrolyzed species, $UO_2(OH)^{1+}$, has been found and equilibrium constants have been calculated for the various hydrolytic and polymeric reactions involved.

The application of ultracentrifuge measurements to the determination of molecular weights of charged metal chelates has been investigated using the 1:1 Th(IV)-diethylenetriaminepentaacetic acid (DTPA) and 1:1.5 Th(IV)-Tiron systems. The Archibald non-equilibrium method of determining molecular weights as described by Klainer and Kegeles has been applied to the methods of dealing with charged polymers as outlined by Johnson, Kraus and Scatchard. The calculated values of the molecular weight of the monomeric Th(IV)-DTPA chelate are approximately ten percent lower than the actual value, presumably because of the fact that a nonideal supporting electrolyte, $NaNO_3$, was employed. Investigation of the 1:1.5 Th(IV)-Tiron system in 1 M NaCl showed that a binuclear chelate is the predominant species although the experimental results indicate that the system may be polydisperse. The effects of varying type and concentration of the supporting electrolyte have been studied and discussed in terms of the primary and secondary salt effects.

Microfilm $2.50; Xerox $5.80. 117 pages.

THE ETHERATES OF MAGNESIUM HALIDES

(L. C. Card No. Mic 59-5494)

B. Kenneth Lewis, Ph.D.
The University of Oklahoma, 1959

Major Professor: H. H. Rowley

Magnesium bromide and magnesium iodide were prepared by reacting magnesium with mercuric bromide and mercuric iodide under ether. The magnesium halides so prepared were found to be more stable than those prepared by direct combination. Anhydrous magnesium chloride was prepared by igniting magnesium chloride hexahydrate and ammonium chloride.

An effort was made to prepare magnesium fluoride by reacting hydrofluoric acid with magnesium carbonate. It was found that heating magnesium fluoride prepared in this manner resulted in the decomposition of the halide. Evidence is presented to show that the magnesium fluoride is oxidized by oxygen.

The methods of analysis of the ether solutions and the magnesium halide etherate crystals are presented.

The solubilities of the magnesium halides in diethyl ether were measured over a temperature range of 0° to 30° C.

Evidence was obtained to point to the existence of magnesium iodide tetra-etherate which is stable to 8° C., magnesium iodide trietherate which is stable to 17° C., and magnesium iodide dietherate which melts under ether at 22.8° C.

Analysis of the crystals of magnesium bromide etherate crystals confirmed the results reported by Rowley in that the dietherate and trietherates were found to exist over the temperature range 0° to 30° C.

Magnesium chloride and magnesium fluoride were found to be very slightly soluble in diethyl ether.

The average heats of solution for magnesium iodide tetraetherate was found to be -6.7 kilocalories over the temperature range -1.5° to 8° C. For the trietherate, the heat of the solution was -11.7 kilocalories over the temperature range 8° to 17° C. The dietherate had an average heat of solution of -19.1 kilocalories over the temperature range 17° to 22.8° C.

Microfilm $2.50; Xerox $3.60. 61 pages.

THE KINETICS AND EQUILIBRIA OF METHYLATED DIBORANES: I. THE ANALYTICAL METHOD, II. AN ACTIVATION ENERGY FOR THE DIBORANE-TRIMETHYLBORANE REACTION, III. THE DECOMPOSITION OF MONOMETHYLDIBORANE.

(L. C. Card No. Mic 59-5470)

John Preston Oliver, Ph.D.
University of Washington, 1959

Chairman: David M. Ritter

The specific retention volumes, V_g, have been determined as functions of temperature for diborane, trimethylborane, and the methyldiboranes on columns packed with mineral oil on pulverized firebrick. Column efficiency was not great, but sufficient to permit almost complete separation of the elution curves at 0°C. and the quantitative determination of the substances to an accuracy of one to two percent of the amounts present in a mixture.

The velocity constants for the reaction of diborane and trimethylborane have been determined at four temperatures between 0°C. and 25°C. The Arrhenius activation energy of the reaction has been determined; the value is 11.3 ± 1.0 kcal./mole.

The disproportionation of monomethyldiborane into diborane and 1,2-dimethyldiborane has been studied from -18°C. to 11°C. It was found to be a complex reaction with the order of the reaction, which varied from 1.5 to 2, dependent on the temperature and surface to volume ratio of the reaction system.

The equilibrium constant for the reaction was determined at several temperatures, the enthalpy of the reaction was found to be 354 cal./mole, and the entropy change, $\Delta S = 3.87 \pm 0.01$ E. U. was calculated.

An approximate value for the bridge-bond dissociation energy of 1,2-dimethyldiborane, 27.2 kcal./mole, was found. Microfilm $2.50; Xerox $4.40. 81 pages.

LIGHT-SCATTERING OF AQUEOUS ALUMINUM NITRATE AND GALLIUM PERCHLORATE SOLUTIONS

(L. C. Card No. Mic 59-6446)

John K. Ruff, Ph.D.
The University of North Carolina, 1959

Supervisor: S. Y. Tyree

The light scattering technique was used to study the cationic aggregation in solutions of aluminum (III) nitrate and gallium (III) perchlorate, prior to their precipitation as the hydrous oxides.

Solutions of aluminum (III) nitrate containing from zero to 2.25 hydroxide ions, (added as sodium carbonate) per aluminum ion and over a total aluminum concentration range of 0.1 to 1.0 molar were prepared. Solutions of gallium III perchlorate were also prepared containing from zero to 2.0 hydroxide ions per gallium ion and over a total gallium concentration of 0.05 to 0.8 molar. Rayleigh turbidities and refractive index increments of the above were determined after suitable aging of the solutions.

It was possible to calculate the weight average molecular weight of the solutes species for each base ration (i.e. the OH/metal ratio) by using the Debye light scattering equation for solutions. In the calculations the effect of interaction between the solute species was neglected. The molecular weights obtained were found to increase as the base ratio increased.

For each solution of a given base ratio, R, an empirical formula for the cationic solute species was assumed, $[Me(H_2O)_{6-R}(OH)_R]_n$, and n, the weight average number of metal ions per cation species was calculated. The value of n was found to increase rapidly with increasing base ratios. This indicates that the extent of aggregation is considerable at the higher base ratios for both the aluminum and gallium systems.

The value of n calculated was found to be in reasonable agreement with the average number of metal ions per cation species reported by earlier investigators. The value of n increased more rapidly than the average number with increasing base ratios as would be expected.

In order to insure that equilibrium conditions were being studied the Rayleigh turbidity was determined as a function of time for a freshly prepared solution. An initial drop in the turbidity was noted in both cases. The aluminum system was found to reach equilibrium within two weeks. However the gallium solutions with base ratios above 1.5 precipitated on standing so that it is not sure whether equilibrium was established in any of the solutions measured.

A pH study was made on a set of gallium(III)perchlorate solutions and the data was interpreted in terms of the core-link mechanism proposed by L. G. Sillen. It was found that the aggregates could be represented by $Ga_{n+1}(OH)_{2n}$ and the value of n was calculated for each base ratio. Microfilm $2.50; Xerox $5.40. 109 pages.

ELECTROCHEMICAL STUDIES IN PYRIDINE

(L. C. Card No. Mic 59-6610)

Tsu Tzu Tsai, Ph.D.
University of Kansas, 1959

1. The anodic oxidation of aluminum in sodium iodidepyridine solution in the presence of benzophenone gives $\bar{V}_i$ values lower than the normal value of three. Anolyte reduction products, namely benzhydrol and benzopinacol, are formed in amounts corresponding to oxidation of aluminum from its measured mean valence state to the familiar tripositive state. The ratio of the two reduction products shows a dependence on the nature of the cation of the electrolyte.

2. The "anodic reduction" by lower valent aluminum of azobenzene, azoxybenzene, and nitrosobenzene has been studied. In each case, a two-electron reduction was observed. The results have been correlated with those obtained in an analogous study with unipositive magnesium, anodically generated, as reducing agent.

3. Electrolysis of bromobenzene between magnesium electrodes in 0.5 m sodium iodide-pyridine solution

results in the formation in each compartment of the cell of benzene, 4,4'-dipyridyl, and a mixture of the three isomeric phenylpyridines, 4-phenylpyridine being the major component in the mixture of isomers. By way of contrast, although the same products are formed when a magnesium anode and a platinum cathode were employed as electrodes, the major component of the isomeric phenylpyridines produced in the catholyte is 2-phenylpyridine. An explanation for this effect is offered.

Microfilm $2.50; Xerox $5.00. 98 pages.

THE REACTIONS OF TRIFLUOROMETHYL HYPOFLUORITE WITH SULFUR TRIOXIDE AND SULFUR DIOXIDE

(L. C. Card No. Mic 59-5479)

Wayne Paul Van Meter, Ph.D.
University of Washington, 1959

Chairman: George H. Cady

This thesis reports an investigation of the reactions of trifluoromethyl hypofluorite, CF_3OF, with sulfur dioxide and sulfur trioxide. It was found that trifluoromethyl hypofluorite reacts with sulfur trioxide in the temperature range 245° to 260° C to yield an addition product melting at -117° and boiling at 12.9°. Its chemical and physical properties indicate that it has the peroxide structure, CF_3OOSO_2F.

Trifluoromethyl hypofluorite reacts with sulfur dioxide in the temperature range 175° to 185° C to yield many products, including a series of four compounds with melting points between -121° and -66° and boiling points between -4.2° and 98°. These substances are trifluoromethyl esters of fluorosulfonic, sulfuric, fluorodisulfuric, and disulfuric acids.

A fractional codistillation technique was used to separate the components of the crude products of the sulfur dioxide reaction. Pure samples were thus obtained without subjecting them to the heat of an ordinary fractional distillation.

Infrared, nuclear magnetic resonance, and mass spectra were used to help establish the structures of the new compounds. The NMR results gave a semi-quantitative measure of the fluorine content of each compound, and a definite knowledge of the number of C-F and S-F bonds in each kind of molecule. Some of the infrared absorption bands were identified by comparison with spectral assignments of other substances with related structures.

The differences in resistance to hydrolysis by aqueous sodium hydroxide solutions have been correlated with the proposed structures. Quantitative analyses were made of the solutions resulting from the basic hydrolyses.

The melting point, vapor pressure curve, boiling point, heat of vaporization, Trouton constant, and gas and liquid densities have been determined for each of the new substances. Microfilm $2.50; Xerox $3.00. 47 pages.

A SPECTROPHOTOMETRIC STUDY OF SELECTED UNSATURATED HETEROPOLY ACIDS

(L. C. Card No. Mic 59-6522)

Gerald Wayne Wallace, Ph.D.
Purdue University, 1959

Major Professor: M. G. Mellon

Although simple heteropoly acids containing vanadium have been known for many years, almost no analytical applications of these unsaturated acids are known. Since these complex acids are intensely colored, an investigation of the possibilities of employing them as a basis for spectrophotometric methods for vanadium was carried out.

A study of the molybdovanadic acid system revealed that a complex acid having a molybdenum to vanadium ratio of five to one exists in the pH range of 3.0 to 3.5. The complex is stable for at least 24 hours. If an excess of molybdate over the stoichiometric ratio is present, the system obeys Beer's law over the concentration range of 0.05 to 1.5 mg. of vanadium per 50 ml.

The procedure based on the 5-molybdovanadic acid complex is very sensitive and is rapid in the absence of iron and chromium, the two principal interfering ions.

The standard deviation ranged from 0.008 to 0.056% on steel samples whose percentage of vanadium ranged from 0.235 to 2.04 for a series of five determinations per sample.

A study was also made of the tungstovanadic acid system. A complex acid is formed by condensation of the oxy-acids of tungsten (VI) and vanadium (V) in the ratio of three to one. This ratio was constant over the pH range of 2 to 6, although evidence indicates a slight change in the complex at pH 4.

A sensitive and rapid spectrophotometric procedure was developed based on the three to one complex. Absorbance measurements are made at 392 mμ. The optimum pH for the maximum color development is 2.0. The principal interfering ion is chromium, since it absorbs in the same spectral region. The interference of iron for the same reason was eliminated by the addition of fluoride.

Analyses of three steel samples for vanadium obtained from the National Bureau of Standards by the procedure developed demonstrated its accuracy and precision. A standard deviation of 0.022% was obtained for seven determinations of vanadium on a steel whose percentage of vanadium was 0.970.

Microfilm $2.50; Xerox $6.10. 143 pages.

A STUDY OF MOLECULAR COMPOUND FORMATION BETWEEN DINITROGEN TETROXIDE AND SOME SULFUR-CONTAINING LEWIS BASES

(L. C. Card No. Mic 59-6115)

Robert Dallas Whitaker, Ph.D.
The University of Florida, 1959

Aliphatic and alicyclic sulfides form addition compounds with dinitrogen tetroxide, provided the temperature is maintained in the neighborhood of -60°. These addition

compounds were studied by means of cryoscopic measurements and dielectric constant measurement in chloroform solutions at low temperatures.

For purposes of comparison, a few ether-dinitrogen tetroxide systems (known to give addition compounds in the solid state) were also studied by means of dielectric constant determinations in chloroform solutions. The sulfides and ethers which were studied included the following: Bis-(chloromethyl) sulfide, dimethyl sulfide, diethyl sulfide, di-n-propyl sulfide, di-n-butyl sulfide, di-isoamyl sulfide, 1,4-dithiane, trithiane, n-butyl ether, 1,4-dioxane, and tetrahydropyran.

The dielectric constant measurements were taken in such a manner that the data are amenable to treatment by Job's method of continuous variations. Cryoscopic measurements and the relatively high solubilities of the sulfide-dinitrogen tetroxide addition compounds in solvents of low polarity indicate that the dinitrogen tetroxide in these compounds is essentially molecular rather than ionic. The dielectric constant measurements indicate, however, that the sulfide-dinitrogen tetroxide addition compounds are much more polar than corresponding ether-dinitrogen tetroxide addition compounds.

Apparent stoichiometries for the addition compounds in chloroform solutions were found for those systems which registered a significant increase in dielectric constant above that of chloroform alone. These mole ratios were found to be the following: 1:1 for $Me_2S:N_2O_4$; 1:2.5 for $Et_2S:N_2O_4$; 1:2 for $(n\text{-}Pr)_2S:N_2O_4$; 1:1.5 for $(n\text{-}But)_2S:N_2O_4$; 1:1.5 for $(i\text{-}Am)_2S:N_2O_4$. The other systems did not register a significant increase in dielectric constant above that for chloroform alone, for the conditions under which they were studied.

At 0^0, dinitrogen tetroxide oxidizes 1,4-dithiane quantitatively to 1,4-dithiane α-disulfoxide and 1,4-dithiane β-disulfoxide. This reaction is analogous to the reaction of dinitrogen tetroxide with aliphatic sulfides to produce the corresponding sulfoxides. The α-disulfoxide predominates as the product in the dithiane oxidation. This disulfoxide forms a white, solid addition compound with dinitrogen tetroxide, which is stable at room temperature. Sublimation of this addition compound at temperatures of 150-90^0 gives 1,4-dithiane monosulfone as a product.

Under oxidizing conditions, dinitrogen tetroxide cleaves the trithiane ring and produces free sulfur, polymeric materials, and volatile sulfur-containing substances.

Microfilm $2.50; Xerox $5.20. 104 pages.

CHEMISTRY, ORGANIC

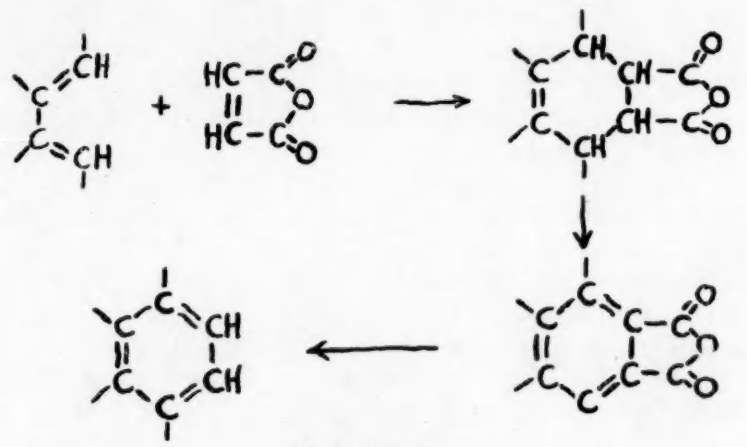
PREPARATION AND REACTIONS OF VINYLENE CARBONATE

(L. C. Card No. Mic 59-6614)

Roger Williams Addor, Ph.D.
The Ohio State University, 1954

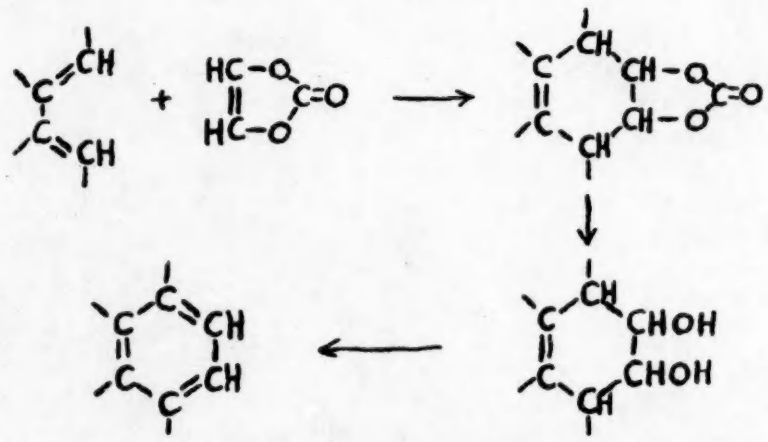
Introduction

The Diels-Alder reaction is used to form six-membered rings from 1,3-diene systems. Maleic anhydride is the dienophile most widely used for this reaction. If aromatization of the new ring is desirable, dehydrogenation and decarboxylation are necessary steps (Scheme 1). The decarboxylation of the 1,2-dicarboxylic acid may be particularly difficult and afford low yields.



Scheme 1

For example, a synthesis of coronene involved, in part, steps as outlined in Scheme 1.[1] In this case, the decarboxylation was finally effected only under drastic conditions and in very small yield. The difficulty of the decarboxylation step in the coronene synthesis led to a consideration of dienophiles other than maleic anhydride. Such a substitute dienophile should not only be reactive enough to undergo the initial Diels-Alder reaction, but should also contain functional groups readily removable to form a new aromatic ring. These requirements led to consideration of the previously unreported vinylene carbonate (A). Thus, according to Scheme 2, the vinylene carbonate-diene adduct would first be hydrolyzed to the corresponding cis-diol and then dehydrated either directly or through a derivative such as the acetate or xanthate. The aromatization and removal of the undesired functional groups would occur as one step. Furthermore, the vinylene carbonate adducts would be of importance in themselves since hydrolysis would complete a synthesis for cis-diols.



Scheme 2

Vinylene carbonate would be of considerable interest as a monomer since polymerization and hydrolysis would yield a polymer with repeating units ~~(CHOH)~~. Also, the use of vinylene carbonate as a copolymer, with or without subsequent hydrolysis, would offer a host of new materials.

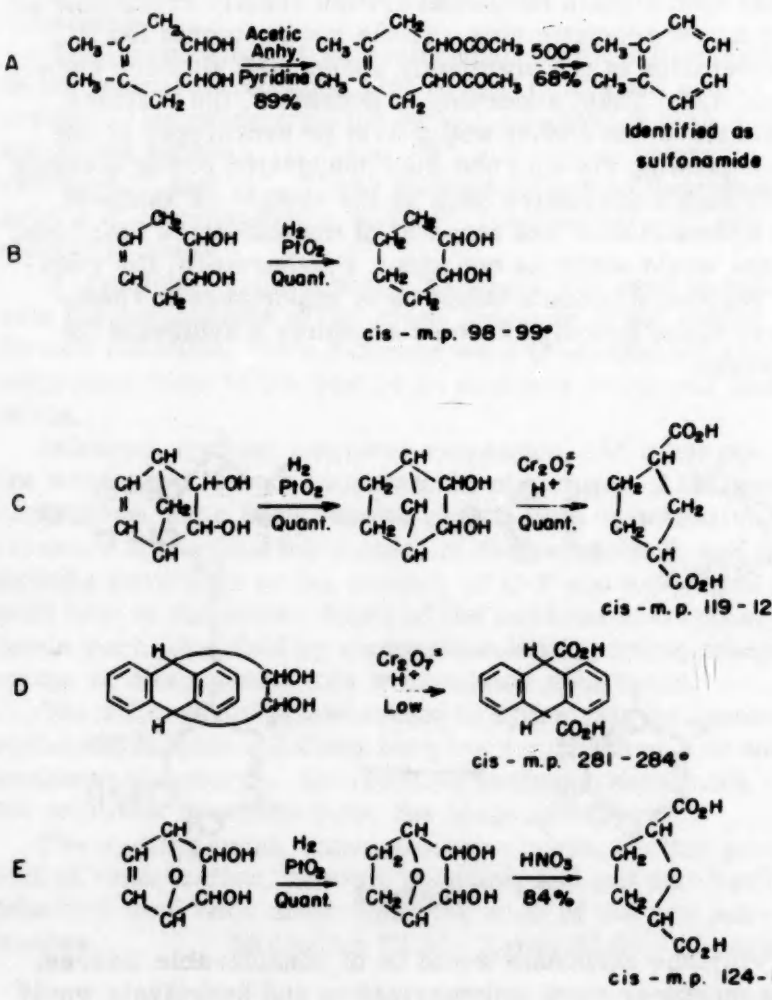
Preparation of Vinylene Carbonate

Ethylene carbonate was chlorinated at 70° to 80° in the presence of strong ultraviolet light. Fractionation of the chlorination mixture afforded a 60 to 69 per cent yield of monochloroethylene carbonate (4-chloro-1,3-dioxolan-2-one, b.p. 129° to 131° at 31 to 32 mm.) and a 5 to 15 per cent yield of dichloroethylene carbonate (4,5-dichloro-1,3-dioxolan-2-one, b.p. 91° to 92° at 34 to 35 mm.).

Vinylene carbonate (1,3-dioxol-2-one, b.p. 76° at 38 to 39 mm.) was prepared by the dehydrochlorination of monochloroethylene carbonate. Eighteen experiments were conducted using triethylamine as the dehydrochlorinating agent. The best yield of vinylene carbonate (72 per cent) was obtained by refluxing a mixture of monochloroethylene carbonate and triethylamine (25 per cent excess) in dry ether for 40 hours. Other amines studied to a lesser extent, which gave smaller yields of vinylene carbonate, were N,N-diethylcyclohexylamine and tri-n-butylamine. Bases used which did not convert monochloroethylene carbonate to vinylene carbonate were tribenzylamine, N-methylpiperidine, potassium t-butoxide, sodium triphenylmethyl, and the basic ion exchange resin Amberlite IR-4B. Trimethylamine formed a quaternary salt with monochloroethylene carbonate in 83 per cent yield.

Vinylene carbonate was prepared in 29 per cent yield by refluxing dichloroethylene carbonate with zinc dust in a 1,2-dimethoxyethane-benzene solvent.

In addition to the analysis, infrared absorption spectrum, and molar refraction, the structure of vinylene carbonate was established by hydrogenation to ethylene carbonate in 76 per cent yield using a 5 per cent rhodium-on-alumina catalyst. Further proof was obtained by hydrolysis of vinylene carbonate to glycol aldehyde which was identified as the phenyl osazone.



STRUCTURE PROOF OF THE DIELS-ALDER ADDUCTS OF VINYLENE CARBONATE

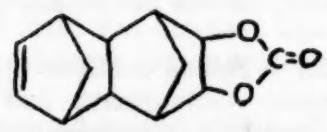
Figure 1

Reactions of Vinylene Carbonate

Diels-Alder Reactions.—Vinylene carbonate proved to be a moderately active dienophile. Solid Diels-Alder adducts were prepared from vinylene carbonate and the following dienes (adduct yields in parenthesis): butadiene (26 per cent), 2,3-dimethylbutadiene (61 per cent), cyclopentadiene (77 per cent), hexachlorocyclopentadiene (80 per cent), anthracene (88 per cent), and furan (34 per cent). No adduct was obtained with 3,4,3',4'-tetrahydro-7,7'-dimethyl-1,1'-binaphthyl, the diene used in a synthesis of coronene.[1]

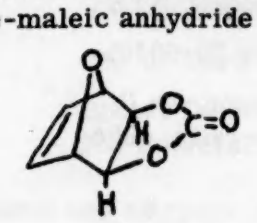
The structures of the Diels-Alder adducts were first inferred from the analyses and infrared spectra. Except for the hexachlorocyclopentadiene adduct, the adducts were converted to the corresponding glycols from which the structures were established by conversion to known compounds as outlined in Figure 1.

In the Diels-Alder reaction with cyclopentadiene (mole ratio of vinylene carbonate to cyclopentadiene 1.9:1) a small amount of a second adduct was formed. Analysis indicated the presence of two moles of cyclopentadiene to one of vinylene carbonate. The structure is probably that shown.

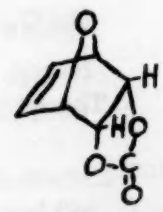


Such analogous secondary adducts have been reported from Diels-Alder additions between cyclopentadiene and allyl cyanide,[2] 1,2-dichloroethylene,[2] vinyl chloride,[3] and vinyl acetate.[3] The structure of the secondary vinyl acetate adduct was established by degradation.[3]

The reaction between vinylene carbonate and furan (mole ratio 3.0:1, respectively) gave three compounds. Two of the compounds were isomeric and were separated by chromatography. After hydrolyzing a sample of the isomer mixture to the corresponding glycol and hydrogenating the double bond, oxidation yielded 84 per cent of 2,5-tetrahydrofuran dicarboxylic acid. The degradation results in conjunction with the infrared absorption curves showed that the two isomers were structurally alike. They are undoubtedly the exo and endo modifications. Normal addition of cyclic dienes to dienophiles usually gives exclusively the endo isomer, and exceptions are rare.[4] Furan and maleic anhydride in ether yield the exo adduct, while with maleic acid in water the endo adduct is formed.[5] Mixtures of exo and endo isomer occur in the substituted fulvene-maleic anhydride adducts.[4]

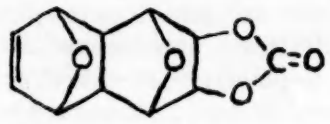


exo

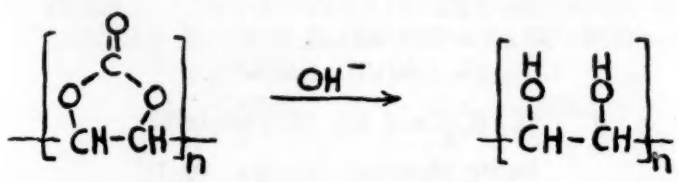


endo

The third compound from the reaction of vinylene carbonate and furan contained (by analysis) two moles of furan per mole of vinylene carbonate. The structure was consistent with the infrared absorption spectrum and with the hydrogenation data.



Polymerization.—Vinylene carbonate was easily converted to clear viscous liquids or tough plastic solids by heating with small amounts of benzoyl peroxide. The solids became hard and brittle after short exposure to the air and darkened without melting when heated above 200°. A film of plastic polymer deposited from acetone, in which it was soluble, showed strong carbonyl absorption at 5.55 μ (1800 cm.$^{-1}$). The polymer, insoluble in water, slowly dissolved in solutions of sodium, potassium, or ammonium hydroxide. Infrared examination of the gelatinous solids which precipitated from a potassium hydroxide solution saturated with the polymer showed hydroxyl group absorption at 3 μ (3320 cm.$^{-1}$), and a lack of absorption in the cyclic carbonate carbonyl range. There is little doubt that the carbonate polymer and the hydrolyzed product have the structures shown.



A sample of the polymer dissolved in concentrated ammonium hydroxide yielded, after removing excess base and ammonium carbonate on the steam bath, a dark solid which showed both hydroxyl (2.9-3.1 μ) and carbonyl (5.7-5.8 μ) absorption in the infrared region. Presumably, partial hydrolysis had occurred to give a product having both of the structural units shown above.

Addition of Bromine.—Although vinylene carbonate would not add bromine at room temperature, refluxing with bromine in carbon tetrachloride yielded dibromoethylene carbonate in 94 per cent yield.

Microfilm $2.50; Xerox $4.80. 91 pages.

1. Newman, M. S., "A New Synthesis of Coronene," J. Am. Chem. Soc., 62 (1940), pp. 1683-87.

2. Alder, K., and Windemuth, E. "On the Diene-Synthesis with Allyl Compounds," Ber., 71 (1938), pp. 1939-57.

3. Alder, K., and Rickert, H. "On the Diene-Synthesis with Vinyl Esters and Halogenated Ethylenes," Ann., 543 (1939), pp. 1-27.

4. Norton, J. A. "The Diels-Alder Diene Synthesis," Chem. Rev., 31 (1942), pp. 498-500.

5. Woodward, R. B., and Baer, H. "Reaction of Furan with Maleic Anhydride," J. Am. Chem. Soc., 70 (1948), pp. 1161-66.

Abstract published by special arrangement with The Ohio State University.

THE SYNTHESIS OF SOME FLUORENE DERIVATIVES AS POTENTIAL SCINTILLATION SOLUTES

(L. C. Card No. Mic 59-6165)

Martin Dennis Barnett, Ph.D.
The University of New Mexico, 1959

Chairman: Associate Professor Guido Herman Daub

Diels-Alder reaction of 1,4-diphenylbutadiene with maleic anhydride yielded 3,6-diphenyl-Δ^4cis-tetrahydrophthalic anhydride, which was dehydrogenated to 3,6-diphenylphthalic anhydride. Treatment of the anhydride with aluminum chloride and decarboxylation of the resulting 2-phenylfluorenone-1-carboxylic acid produced 2-phenylfluorenone, which was reduced to 2-phenylfluorene.

2-Iodofluorene, prepared by allowing 2-fluorenediazonium chloride to react with aqueous potassium iodide, was oxidized to 2-iodofluorenone. Ullmann coupling of two molecules of 2-iodofluorenone yielded 2,2′-bifluorenone, which gave 2,2′-bifluorene on reduction.

Pyrolysis of p-quaterphenyl-2,2′-dicarboxylic acid produced 2-(p-biphenylyl)-fluorenone, which was reduced to 2-(p-biphenylyl)-fluorene.

Treatment of 2-(p-biphenylyl)-fluorenone with methylmagnesium iodide, followed by dehydration and hydrogenation, gave 2-(p-biphenylyl)-9-methylfluorene.

Friedel-Crafts arylation of benzene with N-chloro-o-acetotoluidide, prepared by the N-chlorination of o-acetotoluidide with potassium hypochlorite, gave 3-methyl-4-acetamidobiphenyl. Oxidation of the amide with potassium permanganate, followed by hydrolysis of the product, yielded 5-phenylanthranilic acid, the diazonium salt of which underwent self-coupling in the presence of an ammoniacal cuprous salt solution to give p-quaterphenyl-2″, 3′-dicarboxylic acid. Pyrolysis of the diacid afforded 2,7-diphenylfluorenone, which was reduced to 2,7-diphenylfluorene.

Fluorene-2-carboxylic acid, prepared by the interaction of fluorene with oxalyl chloride in the presence of aluminum chloride, was converted to fluorene-2-carbonyl chloride. The following oxazoles were prepared by known reactions from the acid chloride and the appropriate α-aminoketone: 2-(2-fluorenyl)-5-phenyloxazole, 2-(2-fluorenyl)-5-(p-biphenylyl)-oxazole, 2-(2-fluorenyl)-5-(α-naphthyl)-oxazole, 2-(2-fluorenyl)-5-(β-naphthyl)-oxazole, and 2-(2-fluorenyl)-5-(2,4,6-trimethylphenyl)-oxazole. 2-Phenyl-5-(2-fluorenyl)-1,3,4-oxadiazole was prepared from fluorene-2-carbonyl chloride and benzoylhydrazine by similar reactions.

The five hydrocarbons, the five oxazoles, and the oxadiazole were evaluated as potential scintillation solutes at the Los Alamos Scientific Laboratory.

Microfilm $2.50; Xerox $5.60. 111 pages.

LIQUID SCINTILLATORS. SOME ARYL SUBSTITUTED PHENANTHRENES AND DIHYDROPHENANTHRENES, AND RELATED p-TERPHENYLS AND p-QUATERPHENYLS.

(L. C. Card No. Mic 59-6169)

Stephen Paul Birkeland, Ph.D.
The University of New Mexico, 1959

In connection with the scintillation program being carried out by the Biomedical Research Group, Los Alamos Scientific Laboratory, some aryl substituted phenanthrenes and 9,10-dihydrophenanthrenes were synthesized and tested as liquid scintillators. In addition, a number of p-terphenyl and p-quaterphenyl derivatives were also prepared and tested as liquid scintillation solutes.

2-Phenylphenanthrene and 2-(4-biphenylyl)-phenanthrene were prepared starting with benzyl cyanide and 4-phenylbenzyl cyanide, respectively. The latter starting material was prepared in four steps from 4-phenylbenzoic acid which was reduced to 4-phenylbenzyl alcohol. This alcohol was converted to 4-phenylbenzyl bromide which upon treatment with potassium cyanide afforded 4-phenylbenzyl cyanide.

The alkylation of benzyl cyanide and 4-phenylbenzyl cyanide was accomplished with β-(1-naphthyl)-ethyl bromide to give α-phenyl-γ-(1-naphthyl)-butyronitrile and α-(4-biphenylyl)-γ-(1-naphthyl)-butyronitrile, respectively. These nitriles were hydrolyzed to the carboxylic acids, which in turn were cyclized to the corresponding 1-keto-2-aryl-1,2,3,4-tetrahydrophenanthrenes. Reduction of the ketones followed by dehydration afforded 3,4-dihydro-2-phenylphenanthrene and 2-(4-biphenylyl)-3,4-dihydrophenanthrene which, when heated with 10% palladium-charcoal, yielded 2-phenylphenanthrene and 2-(4-biphenylyl)-phenanthrene, respectively.

Peroxide oxidation of either the hydrocarbons or their quinones gave the corresponding dicarboxylic acids which were reduced via their methyl esters to 2,2'-bis(hydroxymethyl)-p-terphenyl and 2,2'-bis(hydroxymethyl)-p-quaterphenyl, respectively. The diols were converted to their corresponding dibromides, 2,2'-bis(bromomethyl)-p-terphenyl and 2,2'-bis(bromomethyl)-p-quaterphenyl, which were cyclized with phenyllithium to 9,10-dihydro-2-phenylphenanthrene and 2-(4-biphenylyl)-9,10-dihydrophenanthrene, respectively.

2,2'-Bis(bromomethyl)-p-terphenyl and 2,2'-bis(bromomethyl)-p-quaterphenyl were treated with methanolic sodium methoxide to give 2,2'-bis(methoxymethyl)-p-terphenyl and 2,2'-bis(methoxymethyl)-p-quaterphenyl, respectively. Cyclization of 2,2'-bis(hydroxymethyl)-p-terphenyl and 2,2'-bis(hydroxymethyl)-p-quaterphenyl with potassium bisulfate afforded 5,7-dihydro-3-phenyldibenz-[c,e]oxepin and 3-(4-biphenylyl)-5,7-dihydrodibenz[c,e]-oxepin, respectively.

The preparation of 2,7-diphenylphenanthrene and related compounds was accomplished by starting with the previously known p-quaterphenyl-2",3'-dicarboxylic acid. This acid was reduced via its methyl ester to 2",3'-bis-(hydroxymethyl)-p-quaterphenyl which readily afforded 2", 3'-bis(bromomethyl)-p-quaterphenyl. This dibromide was either cyclized with phenyllithium to 9,10-dihydro-2,7-diphenylphenanthrene or treated with methanolic sodium methoxide to yield 2",3'-bis(methoxymethyl)-p-quaterphenyl. The 9,10-dihydro compound was dehydrogenated to 2,7-diphenylphenanthrene. Cyclization of 2",3'-bis(hydroxymethyl)-p-quaterphenyl with potassium bisulfate produced 5,7-dihydro-3,9-diphenyldibenz[c,e]oxepin.

These compounds were tested as organic liquid scintillation solutes. The p-quaterphenyl related oxepins, a dihydro-compounds and dimethoxymethyl compounds were found to be excellent scintillators. 2-Phenyl-3,4-dihydrophenanthrene, 2-phenyl-9,10-dihydrophenanthrene, 5,7-dihydro-3-phenyldibenz[c,e]oxepin and 2,2'-bis(methoxymethyl)-p-terphenyl were fair to good scintillators while the phenanthrene derivatives and the dihydroxymethyl compounds were poor scintillators.

Other data were also obtained regarding the compounds' ultraviolet absorption spectra and ultraviolet induced fluorescence spectra, as well as their Kallmann parameters. On the basis of these results it was possible to point out some specific areas for future work in this field.

Microfilm $2.50; Xerox $5.60. 113 pages.

PART I: THE FORMATION OF A SIX- IN PREFERENCE TO A FIVE-MEMBERED RING SULTONE.
PART II: THE CLEAVAGE OF SULFIDES AND SULFONES WITH ALKALI METALS IN LIQUID AMINES.

(L. C. Card No. Mic 59-6473)

David Newman Burdge, Ph.D.
Purdue University, 1959

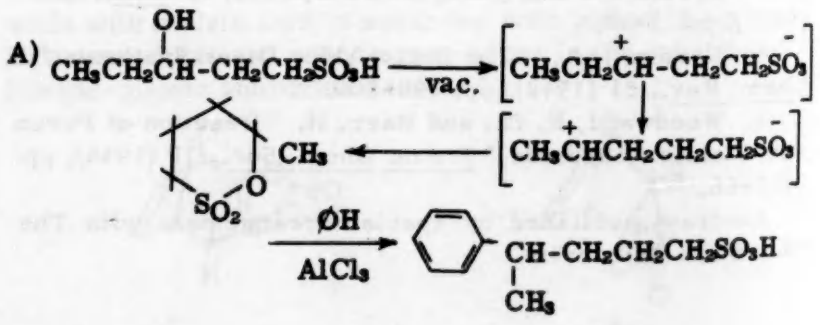
Major Professor: William E. Truce

Part I

Previous work by Helberger and co-workers[1] has indicated that six-membered ring sultones are more stable than their five-membered ring homologs, the opposite of the order of stabilities observed in the lactone series.[2]

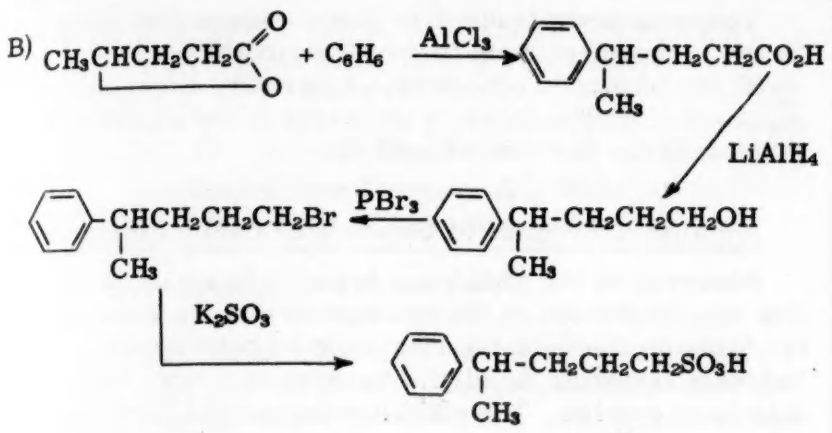
If sultones are formed from hydroxysulfonic acids by way of a carbonium ion intermediate,[3] it seemed quite plausible that a six-membered ring sultone should be formed in preference to a similarly constituted five-membered ring sultone in a situation where an exhibition of a preference was possible.

In this study 3-hydroxypentanesulfonic acid was converted to a sultone which was shown by independent means to be the six-membered ring compound 4-hydroxypentanesulfonic acid sultone.



I

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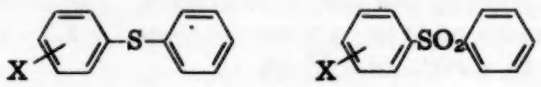
II

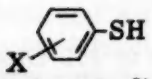
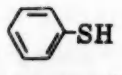
I and II were shown to be identical by a mixture melting determination and by comparison of infra-red spectra of their S-benzylthiouronium salts.

Part II

Previous work in this field[4] has shown that sulfides and sulfones can be cleaved cleanly with sodium in ammonia or lithium in methylamine, the latter being the more general reagent.

This study concerned itself primarily with the cleavage of a number of unsymmetrical diaryl sulfides and sulfones and the determination of the direction of these cleavages:



Compound		
X = p-CH_3 sulfide	28.9 mole %	71.1 mole %
X = m-CH_3 sulfide	51.2 mole %	48.8 mole %
X = p-CH_3O sulfide	0.0 mole %	100 mole %
X = m-CH_3O sulfide	3.9 mole %	96.1 mole %
X = p-CH_3 sulfone	86.5 mole %	13.5 mole %
X = m-CH_3 sulfone	36.9 mole %	63.1 mole %
X = p-CH_3O sulfone	0.0 mole %	100 mole %
X = m-CH_3O sulfone	0.0 mole %	100 mole %

In addition to the investigation of the thiol fraction, the hydrocarbons produced by the cleavage reaction were also investigated, including several compounds which were present in small quantities and which suggested the occurence of various ancillary reactions.

A cursory examination of a possible mechanism for the cleavage reaction is discussed with reference to some of the experiments which provided information in this regard, and a "rule of thumb" is proposed to cover the observed facts. Microfilm $2.50; Xerox $4.80. 94 pages.

FURTHER STUDIES ON THE CHROMIC ACID OXIDATION OF SECONDARY ALCOHOLS

(L. C. Card No. Mic 59-5137)

Jack R. Celeste, Ph.D.
University of Delaware, 1959

Supervisor: William A. Mosher

The effect of various conditions and additives on the chromic acid oxidation of benzpinacolyl alcohol, p-anisyl-t-butylcarbinol, pinacolyl alcohol, phenyl-t-butylcarbinol and p-fluorophenyl-t-butylcarbinol has been studied.

The concentration of chromic acid was found to have a great effect on the product distribution of the oxidation reaction in all the cases studied. The cleavage reaction resulting in an aldehyde and alcohol of lower molecular weight occurred to a greater extent in dilute rather than concentrated chromic acid.

In the presence of sodium acetate the rate of reaction was shown to decrease, and the cleavage reaction increase for every alcohol studied. The cleavage reaction resulting from the chromic acid oxidation of benzpinacolyl alcohol increased from 36% to 75% in the presence of sufficient sodium acetate. Similarly the cleavage reaction observed for p-anisyl-t-butylcarbinol increased from 36% to 88%.

The presence of pyridine in the chromic acid oxidation of the alcohols studied also had a great effect on the product distribution of the reaction. Pyridine increased the cleavage reaction from 36% to 58% in benzpinacolyl alcohol oxidations and increased the cleavage reaction from 36% to 51% in phenyl-t-butylcarbinol oxidations. When pinacolyl alcohol was oxidized with chromic acid in the presence of pyridine, the observed cleavage reaction decreased from 7% to 0.8%.

The chromic acid oxidation of benzpinacolyl alcohol in aqueous acetic acid in the presence of manganous ion increased the observed cleavage reaction from 36% to 99%. When p-anisyl-t-butylcarbinol was oxidized in the presence of manganous ion, the cleavage reaction was reduced from 36% to 15%. In all the other alcohols studied, the cleavage reaction was completely eliminated by the presence of sufficient manganous ion.

Trisodium chromate, a salt known to contain chromium in the pentavalent state, was prepared and used to oxidize benzpinacolyl alcohol and pinacolyl alcohol in 90% aqueous acetic acid. In both cases, the observed cleavage reaction over that observed for chromic acid was greatly increased.

The kinetics of the chromic acid oxidation of phenyl-t-butylcarbinol, p-anisyl-t-butylcarbinol and pinacolyl alcohol were studied in 86.5% and 90% aqueous acetic acid. The reaction was shown to be first order with respect to chromic acid, carbinol and initial hydrogen ion concentration for all these alcohols. The approximate initial hydrogen ion concentrations were calculated from the auto protolysis constants of 86.5 and 90% acetic acid assuming complete ionization of the chromic anhydride in these solvents.

A mechanistic path which is a modification of the one proposed by F. H. Westheimer in 1956 is presented and shown to be in accord with the kinetically derived rate expression:

$$v = -d(CrO_3)/dt = K_3(\text{carbinol})(HCrO_4^-)(H^+)$$

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

From the kinetic data, the activation energies and entropies of activation for the alcohols studied kinetically were calculated. Possible transition states in accord with the experimental evidence were proposed in order to indicate how the reaction products may possibly form.

Microfilm $2.50; Xerox $6.60. 137 pages.

A STUDY OF VARIOUS UNSATURATED ORGANIC COMPOUNDS

(L. C. Card No. Mic 59-6732)

Shih Hsi Chu, Ph.D.
The University of Texas, 1958

Supervisor: Lewis F. Hatch

This dissertation is concerned with four general research problems. Each will be discussed separately.

Halopropargyl Ethers and Alcohols.

The object of this research was to prepare certain halopropargyl compounds to be tested as to their influence on flame propagation in a continuing research program supported by the U.S. Air Force. The following three compounds were synthesized:

3-Bromo-2-propyn-1-ol	$Br-C\equiv C-CH_2OH$
1-Bromo-3-ethoxy-1-propyne	$Br-C\equiv C-CH_2OCH_2CH_3$
1-Bromo-3-phenoxy-1-propyne	$Br-C\equiv C-CH_2OC_6H_5$

In addition to the above three compounds the following two intermediates are also new compounds:

1,1-Dibromo-3-ethoxy-1-propene	$CBr_2=CHCH_2OCH_2CH_3$
1,1-Dibromo-3-phenoxy-1-propene	$CBr_2=CHCH_2OC_6H_5$

The 1-Bromo-1-chloro-1-propenes.

It appeared feasible from steric considerations to prepare both stereoisomers (cis and trans) of 1-bromo-1-chloro-1-propene by the addition of bromine to cis-1-chloro-1-propene and trans-1-chloro-1-propene followed by dehydrobromination of the resulting stereoisomeric 1, 2-dibromo-1-chloropropanes.

The addition product from cis-1-chloro-1-propene dehydrobrominated less readily to produce trans-1-bromo-1-chloro-1-propene(H,Br) than the product from the trans isomer to give cis-1-bromo-1-chloro-1-propene(H,Br). The dehydrohalogenation of 1-bromo-1-chloro-1-propene from cis-1-chloro-1-propene gave only 1-chloro-1-propyne as would be expected with the hydrogen atom and bromine atom in a trans position. The unreacted 1-bromo-1-chloro-1-propene, however, had an infrared spectrum identical with that of the product from trans-1-chloro-1-propene. The 1-bromo-1-chloro-1-propene from the 90% trans-1-chloro-1-propene also gave 1-chloro-1-propyne as the only product. The yield was very low and may have come from the 10% of cis-1-chloro-1-propene present in the original trans-1-chloro-1-propene. cis-1-Bromo-1-chloro-1-propene(H,Br) would not be expected to dehydrobrominate by cis elimination of the elements of H-Br.

The reason why trans-1-bromo-1-chloro-1-propene (H,Br) is more resistant to dehydrobromination than the cis(H,Br) isomer is not known. Apparently either the assignment of configuration is incorrect or the elimination reaction is not the conventional E_2.

Addition of Bromine to Unsaturated Cyclic Compounds.

Research on the addition of bromine to cyclic polyolefins was predicated on the assumption that the location of the bromine atoms on the ring could be determined by selectively removing the allylic bromine atoms by lithium aluminum hydride. The experimental results, however, show that all of the bromine atoms are removed. The allylic bromine atoms were replaced by hydrogen atoms as expected and the non-allylic bromine atoms were involved in a dehydrobromination reaction to form a double bond.

Although it was not possible to follow the course of 1, 2-, 1,4- and 1,6-addition by selectively removing the allylic bromine atoms by lithium aluminum hydride, the same information was obtained by analysis of the hydrocarbons formed by complete removal of bromine by this reagent.

Index of refraction data indicate that the addition of bromine to cyclohexadiene was in a ratio of 30:70, 1,2-addition to 1,4-addition. Similar data indicate a 35:65 ratio of 1,2- to 1,4-addition of bromine to cycloheptadiene. The three component mixture obtained from cycloheptatriene was analyzed by gas chromatography. The data indicate that bromine adds to cycloheptatriene by 1,2- 1,4- and 1,6-addition in a ratio of 9:35:56.

Rates of Reaction of 1,1-Dihalo-3-chloro-1-propenes with Potassium Iodide in Acetone.

Kinetic data have been outlined for the reaction of 1,1, 3-trichloro-1-propene with potassium iodide in acetone at 0°, 5° and 10°. From these data the energy of activation for the reaction was calculated by use of the Arrhenius equation to be 12 kcal/mole. The straight line relationship between ln k and 1/T indicates that k at 20° would be ca. 49. This figure represents a relative reactivity for 1, 1,3-trichloro-1-propene of ca. 98 (allyl chloride as 1.00 with k = 0.502).

An attempt was made to obtain similar data for 1,1-dibromo-3-chloro-1-propene but the reaction was too fast at -10° to give acceptable kinetic data. Three points were obtained which gave an average k value of 151 ± 5. Apparently steric, inductive and resonance effects all influence the reactivity of the allylic chlorine atom and this makes it difficult to relate cause and effect.

Microfilm $2.50; Xerox $7.20. 151 pages.

THE SYNTHESIS OF α-METHOXYARYLACETIC ACIDS AND STUDIES OF ALDEHYDE REACTIVITIES

(L. C. Card No. Mic 59-3011)

Edward Lyon Compere Jr., Ph.D.
University of Maryland, 1958

Supervisor: Professor Wilkins Reeve

The preparations of some α-methoxyarylacetic acids and their salts are described. The preparations were accomplished by the one-step conversion of an arylaldehyde, bromoform and potassium hydroxide in methanol to the corresponding α-methoxyarylacetic acid. The compounds synthesized were o-chloro-α-methoxyphenylacetic acid, ammonium m-chloro-α-methoxyphenylacetate, p-chloro-α-methoxyphenylacetic acid, ammonium o-fluoro-α-methoxyphenylacetate, ammonium m-fluoro-α-methoxyphenylacetate, p-fluoro-α-methoxyphenylacetic acid, ammonium α-methoxy-o-toluacetate, ammonium α-methoxy-p-toluacetate ammonium α-methoxy-m-nitrophenylacetate, α-methoxy-3,4-methylenedioxyphenylacetic acid, ammonium 2,6-dichloro-α-methoxyphenylacetate, α-methoxy-1-naphthylacetic acid, α-methoxy-2-naphthylacetic acid, ammonium α-methoxy-α-phenylpropionate, ammonium α-methoxy-2-thiopheneacetate and sodium α-methoxy-2,4,6-trimethylphenylacetate.

The yields obtained varied between 1% and 79% of the theoretical amounts. Benzaldehydes substituted with electron withdrawing groups such as halogens gave excellent yields. Benzaldehydes substituted with electron releasing groups such as methyl gave 25-50% yields. Benzaldehydes substituted in the 2,6- positions gave poor (1-2%) yields. The yields were correlated where possible with the yields obtained in the Perkin reaction and with Hammett's sigma values.

In eight of the syntheses it was possible to form sodium acid salts by treating a methanolic solution of the half neutrallized acid with a concentrated aqueous sodium chloride solution, and the acids were purified by means of these salts. In those cases where the sodium acid salts would not form under these conditions, it was possible to purify the acids by recrystallization of their ammonium salts. The solubilities in water of six of the less soluble sodium acid salts were determined. Sodium hydrogen di(α-methoxy-2-naphthylacetate) and sodium hydrogen di(p-chloro-α-methoxyphenylacetate) were found to be considerably less soluble than sodium hydrogen di(α-methoxyphenylacetate) itself. Sodium hydrogen di(α-methoxy-2-naphthylacetate) was found to be less soluble than any other sodium acid salt yet reported. α-Methoxy-1-naphthylacetic acid forms a difficultly-soluble normal lithium salt, and the solubility of this salt in water, ethanol, and acetone was determined.

In addition, three nitrogen compounds were prepared which vary slightly in structure from the commercial available isopropyl 3-chlorophenylcarbonate. The compounds prepared were N-hydroxy-N-phenylurea, N-(chloroacetyl)phenylhydroxylamine and N-(chloroacetyl)-m-chlorophenylhydroxylamine.

Microfilm $2.50; Xerox $4.00. 73 pages.

SOLVENT AND SUBSTITUENT EFFECTS ON THE ULTRAVIOLET SPECTRA OF SOME PARA DISUBSTITUTED BENZENE DERIVATIVES

(L. C. Card No. Mic 59-5482)

James Milton Craven, Ph.D.
University of Washington, 1959

Chairman: W. M. Schubert

The position of the principal band in the ultraviolet spectra of a number of para substituted nitrobenzenes and acetophenones was measured in the gas phase and in solution. Normally electron releasing substituents stabilize the excited state relative to the ground state in the order $(CH_3)_2N > NH_2 > MeO > OH >$ t-Bu $>$ Me $>$ H. Correlation of the excitation energies with Brown's σ^+ constants indicates that a large electron demand is made on the para substituent in the excited state.

Normally electron withdrawing substituents in the para position of the nitrobenzenes also stabilized the excited state relative to the ground state, in the order $COCH_3 > CHO > NO_2 > CN > COOCH_3 >$ H. The effect of these substituents was rationalized in terms of the polarizability of the substituent, which was postulated to override the electronegativity of the substituent under conditions of high electron demand. In acidic solvents the order of the excitation energies for these substituents changed. The relative solvent shifts were found to be a function of the basicity of the para substituent and the acidity of the solvent.

In the p-halonitrobenzenes and p-haloacetophenones, the halogens stabilize the excited state relative to the ground state in the order I > Br > Cl > F > H. The molar refractions of the compounds were measured and found to be in the same order. An approximate linear relationship was found between the excitation energies and the molar refractions. It was concluded that under conditions of high electron demand, the halogens are stabilizing in proportion to the polarizability of the C-X electrons. Stabilization by halogen was postulated to be due either to electron release across the C-X bond or to polarization of the substituent across space. The order of the excitation energies of the halogen compounds remained unchanged in solution. The solvent shifts were interpreted in terms of solvation at three sites in the molecule with the order of importance, nitro or acetyl group > ring > halogen. The quantity, ν_X, was linear with ν_H. The slope was found to be related to Hammett's σ constant.

In the para substituted anilines, anisoles and phenols, stabilization of the excited state relative to the ground state by a para substituent was in the order I > Br, Cl > t-Bu, Me > H > F. The molar refractions of the p-haloanisoles were in the order I > Br > Cl > H > F, showing that stabilization by halogen in the excited state parallels the polarizability of the C-X electrons. A comparison of the relative spreads in excitation energies indicated that the para substituent is called upon to withdraw electrons in the excited state in the order, phenols > anisoles > anilines. Solvent effects on the excitation energies established that the electron migration in the electronic transition is directed toward the para substituent.

Microfilm $2.50; Xerox $8.80. 192 pages.

REACTIONS OF NITRO ALKANES WITH OLEFIN OXIDES

(L. C. Card No. Mic 59-5976)

Frank J. Donat, Ph.D.
Case Institute of Technology, 1959

This investigation was undertaken to determine the nature of the reaction of an olefin oxide with a nitro alkane. The study may conveniently be divided into three parts: (a) The effects of catalysts; (b) The effects of the nature of the nitro alkane and olefin oxide; and (c) The effect of temperature upon the reaction.

Acid catalysts seemed to induce transformations in the olefin oxide only, while pyridine appeared to be unique among the basic catalysts in being able to induce extensive reaction other than tar formation. Reactions involving a number of olefin oxides and nitro alkanes were carried out in the presence of pyridine to investigate the effects of structure of the reactants on the course of the reaction. The olefin oxides differed slightly in reactivity but gave essentially similar products. However, the products changed radically with a change in the nitro alkane. Nitromethane was found to yield a 1-(2-hydroxyalkyl)pyridinium nitrite and tars, while nitroethane yielded 3,4,5-trimethylisoxazole; 1-(2-hydroxyalkyl)pyridinium nitrite; tars and a possible trace of a nitroalcohol. Secondary nitro alkanes yield, depending on the steric requirements of the substituted groups, ketones, ketone oximes, 1-(2-hydroxyalkyl)-pyridinium nitrite, ditertiary vic-dinitro alkane, 1,3-nitroalcohol and tars. Low temperatures seem to favor the reactions of primary nitro alkanes, while higher temperatures favor the reactions of secondary nitro alkanes.

The data seem to indicate that the actual catalyst for the reaction is a much stronger nucleophilic agent than pyridine. We propose that the nucleophilic agent is either a complex or an internal pyridinium salt formed from the pyridine and the olefin oxide.

Microfilm $2.50; Xerox $3.80. 69 pages.

THE BASE CATALYZED METHANOLYSIS OF META AND PARA ALKYL SUBSTITUTED 1-MENTHYL BENZOATES

(L. C. Card No. Mic 59-5375)

Eliot Knights Easterbrook, Ph.D.
The Ohio State University, 1953

Introduction

The dissertation is a discussion of a study undertaken to obtain further information on the alkyl series, methyl, ethyl, isopropyl, and t-butyl, when attached to a conjugated system. Two distinct orders of electron release have been observed for this series, the hyperconjugative and the inductive order. In the former the magnitude of electron release increases from the t-butyl to the methyl group, whereas in the latter it decreases. The purpose of studying the rates of methanolysis of the meta and para alkyl substituted 1-menthyl benzoates was to determine which order of electron release would be predominant. When the alkyl groups are in the meta position, the predominance of the inductive effect can be predicted. This is possible since the alkyl groups are not conjugated with the reactive center when in the meta position. In the para position, however, it would be possible to observe either order or a mixed order. Since the reaction studied[1] is not aided by electron release by the substituents, only that portion of the hyperconjugative and inductive effect that is permanent will be operative.

Experimental

Since only the toluic acids were available commercially, it was necessary to synthesize the higher homologues. For the meta derivatives a many-step synthesis (illustrated in Fig. 1) was used. This synthesis was unique in

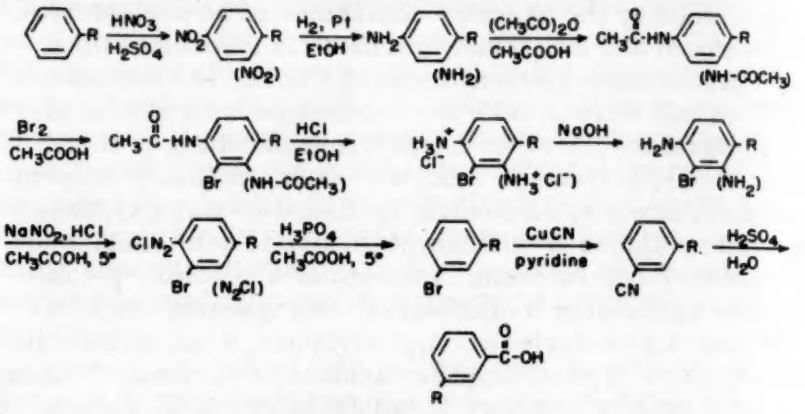


Figure I. Reaction Scheme for Preparation of m-Alkylbenzoic Acids

that no separation of the ortho and para isomers of the initial nitration reaction was necessary. Both isomers, when carried through the series of reactions, would yield the same isomeric alkylbenzoic acid. The para acids were synthesized by one of two methods. The first consisted of the bromination of the alkylbenzene, the formation of the nitrile with cuprous cyanide, and then acid hydrolysis to the benzoic acid. The second method consisted of a Friedel-Craft's reaction between the alkylbenzene and chloroacetyl chloride. After formation of the pyridinium salt of the resulting substituted phenacyl chloride, treatment with sodium hydroxide produced the sodium salt of the desired acid. Preparation of the 1-menthyl esters was accomplished by first preparing the acid chlorides and then reacting them with an equivalent amount of 1-menthol. The esters prepared, along with their physical constants, are listed in Table I.

Table I

Physical Constants of the 1-Menthyl Esters

Ester	Boiling Pt.	Refractive Index
m-ethylbenzoate	144° @ 0.6mm.	1.5060 (27°)
p-ethylbenzoate	151° @ 0.8mm.	1.5078 (26°)
m-isopropylbenzoate	148° @ 0.5mm.	1.5032 (25°)
p-isopropylbenzoate	155° @ 0.5mm.	1.5044 (29°)
m-t-butylbenzoate	159° @ 0.8mm.	1.5012 (30°)
p-t-butylbenzoate	168.5° @ 0.8mm.	1.5050 (27°)

The over-all rate of the sodium methoxide catalyzed ester interchange between the 1-menthyl esters and methanol can be expressed by the following equation:

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$$\frac{-d\,[Ester]}{dt} = k_0\,[MeOH][Ester] + k\,[MeONa][Ester][MeOH]$$

Rearranging and assuming the concentration of methanol to be constant, we obtain

$$\frac{-d\,[Ester]}{dt} = (k_0 + k\,[MeONa]\,)\,[Ester]$$

$$\text{or } \frac{-d\,[Ester]}{dt} = k_1\,[Ester], \text{ where } k_1 = k_0 + k\,[MeONa]$$

By observing the change of rotation (a) with time, it was possible to determine k_1 (first order rate constant) from a plot of log $(a_\infty - a)$ vs. time t. The specific rate constant (k) could then be evaluated

$$\log\,(a_\infty - a) = k_1\,t + c$$

by determining the first order rate constant at various concentrations of sodium methoxide, plotting k_1 vs. [MeONa], and then determining the slope of the resulting straight line. Calculation of the activation energies and $\log_{10}PZ$ values was possible by the determination of the rate constants at two different temperatures.

In addition to the rate study, the ionization constants of the alkylbenzoic acids were determined in 48 per cent (weight) dioxane -52 per cent water. This solvent was used because of solubility difficulties. The constants were determined by the method of one-half end point in the titration curve at 25° with a Beckman pH meter which was standardized against aqueous buffers of pH 7 and pH 4. The equation for the ionization of the weak acid is $HX \rightleftharpoons H^+ + X^-$. The ionization constant is defined by the expression:

$$K_i = \frac{[H^+]\,[X^-]}{HX}$$

At the one-half end point, $[X^-] = [HX]$, and therefore $K_i = [H^+]$ or $pk_i = pH$.

Summary of Results

Table II

Methanolysis of Meta and Para Substituted 1-Menthyl Benzoates Catalyzed by Sodium Methylate

Substituent and position	30.0° k x 10^4 sec^{-1}	39.95° k x 10^4 sec^{-1}	Ecal	$\log_{10}PZ$
H	0.519	1.294	17,600	8.33
p-CH_3-	0.218	0.616	18,030	8.33
m-CH_3-	0.388	1.000	17,740	8.37
p-C_2H_5-	0.255	0.734	20,040	9.86
m-C_2H_5-	0.415	1.051	17,630	8.32
p-i-C_3H_7-	0.271	0.741	19,070	9.18
m-i-C_3H_7-	0.432	1.211	19,530	9.71
p-t-C_4H_9-	0.296	0.768	18,070	8.49
m-t-C_4H_9-	0.435	1.233	19,800	9.91

Table III

Ionization Constants of Alkylbenzoic Acids Obtained in 48% (Wt.) Dioxane -52% Water at 25°

Acid	pk_i	pk_i"	Ave.	k_i x 10^7
benzoic	6.00	6.00	6.00	10.0
p-toluic	6.22	6.215	6.218	6.0
p-ethylbenzoic	6.22	6.22	6.22	6.0
p-isopropylbenzoic	6.225	6.23	6.228	5.9
p-t-butylbenzoic	6.22	6.225	6.222	6.0
m-toluic	6.15	6.14	6.145	7.2
m-ethylbenzoic	6.175	6.18	6.178	6.6
m-isopropylbenzoic	6.22	6.21	6.215	6.1
m-t-butylbenzoic	6.23	6.22	6.225	6.0

Discussion and Conclusions

The base catalyzed methanolysis of the l-menthyl benzoates involves a nucleophilic attack as the rate-determining step and is therefore favored by electron-attracting, and suppressed by electron-releasing, groups. In conformity with the above statement, all alkyl groups should decrease the rate of reaction relative to that of the unsubstituted molecule. Examination of the results obtained (Table II) reveals the expected result that all the alkyl groups depress the velocity of reaction. There is also apparent a small increase from p-methyl to p-t-butyl. This indicates that the permanent hyperconjugation effect is predominant over the permanent inductive effect; i.e., the magnitude of electron release increases from the t-butyl to the methyl group. This order of electron release confirms the results obtained by Berliner and co-workers[2] in their work on the alkaline hydrolysis of the ethyl benzoates in 85 per cent ethanol.

As with the p-alkyl groups, the m-alkyl groups decrease the rate of reaction relative to that of the unsubstituted. Examination of the results (Table II) also shows that there is a small increase in rate from the p-methyl to the p-t-butyl. This is unexpected since a group in the meta position is not conjugated with the reactive center and therefore they should not exhibit any hyperconjugative order of electron release. A possible explanation of these results is that there is some steric strain in the l-menthyl m-alkylbenzoates. This strain could result from the steric interaction between the alkyl groups and the l-menthyl group and would tend to increase the rate of formation of the methyl ester, where no strain would be present. The strain and therefore the rate of reaction would increase progressively from the m-methyl to the m-t-butyl l-menthyl benzoate, since the size of the groups increase in this order. It is interesting to note that H. C. Brown and B. Kamer[3] have presented evidence which indicates the existence of steric interaction between the two t-butyl groups in 2,6-di-t-butylpyridine. The pK_a value (50 per cent EtOH at 25°) for this base was unusually low compared to other substituted 2,6-pyridines. They proposed that the low pK_a was due to steric strain in the 2,6-di-t-butylpyridinium ion. They also postulated that this interaction should be present in m-di-t-butylbenzene. In addition, a Fisher-Hirschfelder type model of the l-menthyl m-t-butylbenzoate molecule exhibited steric interaction when the carbonyl group was planar to the benzene ring. The

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activation energies and $\log_{10}PZ$ factors were determined, but no definite conclusions could be drawn from these values.

Examination of the ionization constants (Table III) obtained for the p-alkylbenzoic acids shows that there is little difference among the various members of the series. All of the values are within experimental error of one another. With the m-alkylbenzoic acids, however, there is a greater separation in the ionization constants. A decrease in the ionization constants is observed on proceeding from the m-methyl to the m-t-butylbenzoic acid. This indicates that the permanent inductive effect is predominant in this situation.

Microfilm $2.50; Xerox $5.40. 109 pages.

1. Taft, R. W., Jr., Newman, M. S., Verhoek, R. H. "The Kinetics of the Base-catalyzed Methanolysis of Ortho, Meta, and Para Substituted l-Menthyl Benzoates," J. Am. Chem. Soc., 72 (1950), pp. 4511-4519.

2. Berliner, E., Beckett, M. C., Blommers, E. A., and Newman, B. "The Alkaline Hydrolysis of Ethyl p-Alkyl Benzoates," J. Am. Chem. Soc., 74 (1952), pp. 4940-4944.

3. Paper 27 presented before the Organic Division at the Chicago American Chemical Society meeting in September, 1953.

Abstract published by special arrangement with The Ohio State University.

DERIVATIVES OF 3,5-THIOMORPHOLINEDIONES AND 2,3-DIHYDRO-4H-1,4-THIAZIN-3-ONES

(L. C. Card No. Mic 59-5139)

James Stewart Elmslie, Ph.D.
University of Delaware, 1959

Supervisor: Glenn S. Skinner

Due to the interest in compounds having a 1,4-thiazine ring in connection with hypnotics and anticonvulsants, a series of 2,2,6-trisubstituted-3,5-thiomorpholinediones (I) and a series of 2,2,5-trisubstituted-2,3-dihydro-4H-1,4-thiazin-3-ones (II) have been prepared. A disubstituted mercaptoacetic acid or amide was condensed with a monosubstituted α-bromoacetic acid or amide to produce a diamide (III) or either of the possible amic acids (IV). Some of these compounds (III and IV) have two asymmetric carbon atoms, and several of these were separated into two racemates. Some of the reactions of these racemates were studied. I was obtained from IV by pyrolysis, and from III by refluxing in concentrated acid. Even though some of the thiomorpholinediones have two centers of asymmetry, no evidence was obtained which would indicate that two racemates were formed.

The 2,3-dihydro-4H-1,4-thiazin-3-ones (II) were prepared by condensing a disubstituted mercaptoacetamide with an α-haloaldehyde or ketone. An intermediate (V) was isolated and was shown to be 2,2,5-trisubstituted-1,4-thiazan-3-on-5-ol. V produced II on heating. Oxidation of II with hydrogen peroxide in acetic acid produced the corresponding sulfone in two cases and a sulfone-epoxide of structure 2,2-diethyl-5,6-epoxy-2,3,5,6-tetrahydro-4H-1,4-thiazin-3-one 1,1-dioxide in a third case.

Some of the compounds prepared possessed anticonvulsant and hypnotic activity, but none were outstanding.

Microfilm $2.50; Xerox $4.60. 89 pages.

SYNTHESIS AND SELECTIVITY OF SCHMIDT REACTIONS OF DISUBSTITUTED TEREPHTHALIC AND ISOPHTHALIC ACIDS

(L. C. Card No. Mic 59-5892)

Derry Lee Fishel, Ph.D.
The Ohio State University, 1959

Monosubstituted benzenedicarboxylic acids in which one of the carboxyl groups is adjacent to the substituent react with hydrazoic acid in sulfuric acid (the Schmidt reaction) with selective replacement of the hindered carboxyl group to give amino acids. To determine the relative effects of substituents on Schmidt reactions of aromatic acids, the synthesis and reactions of 2,5-disubstituted terephthalic and 4,6-disubstituted isophthalic acids with hydrazoic acid were investigated.

New or improved methods for synthesis of substituted terephthalic and isophthalic acids were developed. These include (1) a general synthesis of benzenedicarboxylic acids by oxidation of arylmethyl groups with aqueous sodium or potassium dichromate at 250°; (2) synthesis of 2-bromo-5-methoxyterephthalic and 2-bromo-5-methylterephthalic acids from methoxyterephthalic and methylterephthalic acids by bromination using bromine and silver sulfate in sulfuric acid; (3) synthesis of 5-substituted-2-nitroterephthalic acids from the corresponding monosubstituted terephthalic acids by nitration with an equivalent amount of nitric acid at 60-70°; and (4) synthesis of 2-isopropyl-5-methylterephthalic, 2-chloro-5-methylterephthalic, and 4-methoxy-6-methylisophthalic acids by hydrolysis of the corresponding bis-nitriles obtained by a modified Rosenmund-Von Braun reaction of disubstituted-dibromobenzenes with cuprous cyanide in dimethyl formamide.

Selective reaction with hydrazoic acid in sulfuric acid at 45° was observed for the following acids: (1) for 2-bromo-5-nitroterephthalic and 2-methoxy-5-nitroterephthalic acids, the carboxyl group adjacent to the nitro group was replaced to yield 2-substituted-4-amino-5-nitrobenzoic acids; (2) 2-bromo-5-chloroterephthalic and 2-bromo-5-methoxyterephthalic acids for which the carboxyl group adjacent to the bromine was selectively replaced to give 2-substituted-4-amino-5-bromobenzoic acids; (3) 2-bromo-5-methylterephthalic and 2-chloro-5-methylterephthalic acids for which the carboxyl group adjacent to the methyl group was replaced to yield 2-substituted-4-amino-5-methylbenzoic acids; (4) 4-chloro-6-nitroisophthalic acid to give 5-amino-2-chloro-4-nitrobenzoic acid; and (5) 4-bromo-6-chloroisophthalic acid to give 5-amino-4-bromo-2-chlorobenzoic acid.

2-Isopropyl-5-methylterephthalic acid reacted with hydrazoic acid to give only 2-isopropyl-5-methyl-p-phenylenediamine regardless of the concentration of the sulfuric acid solvent (from 80-107%), the proportion of hydrazoic acid used, or the temperature (from 0-45°). 2-Bromo-5-methoxyterephthalic acid reacted with hydrazoic acid in sulfuric acid concentrations from 80 to 100%

to give only 2-bromo-5-methoxy-p-phenylenediamine; when the sulfuric acid concentration was 107%, 4-amino-5-bromo-2-methoxybenzoic acid was the product. All other 2,5-disubstitutedterephthalic acids gave as minor products diamines resulting from replacement of both carboxyl groups.

New compounds prepared were 2-methyl-5-nitroterephthalic acid, 2-bromo-5-methylterephthalic acid, 2-methoxy-5-nitroterephthalic acid, 2-chloro-5-methylterephthalic acid, 2-chloro-5-methylterephthalonitrile, 2-isopropyl-5-methylterephthalic acid, 2-isopropyl-5-methylterephthalonitrile, 4-bromo-6-chloroisophthalic acid, 4-amino-5-bromo-2-chlorobenzoic acid, 2-bromo-5-methoxy-p-phenylenediamine (bis acetyl derivative), 4-amino-5-bromo-2-methoxybenzoic acid, 2-bromo-5-methyl-p-phenylenediamine (bis acetyl derivative), 4-amino-2-bromo-5-methylbenzoic acid, 2-chloro-5-methyl-p-phenylenediamine (bis acetyl derivative), 4-amino-2-chloro-5-methylbenzoic acid, and 5-amino-4-bromo-2-chlorobenzoic acid.

Microfilm $2.50; Xerox $7.00. 146 pages.

KINETIC STUDIES OF THE ADDITION OF BENZENESULFINIC ACID TO ACTIVATED DOUBLE BONDS

(L. C. Card No. Mic 59-5141)

George Constantine Gatos, Ph.D.
University of Delaware, 1959

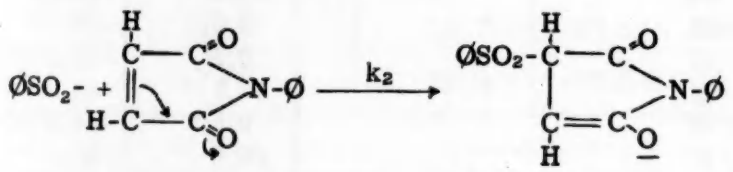
Supervisor: Harold Kwart

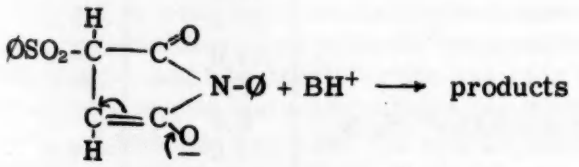
The kinetics of the addition of benzenesulfinic acid to N-phenylmaleimide have been studied by a spectrophotometric method. The effects of solvent, temperature, salts, pH of the solution, sulfuric acid, and the strength of the benzenesulfinic acids were studied. The effect of substituents on benzenesulfinic acid and the effect of substituents of N-phenylmaleimide were also studied.

The rate of the reaction was found to be dependent upon the ionization of sulfinic acid and upon the nucleophilicity of sulfinate anion.

The course of the reaction postulated to account for the experimental results is the following:

$$\text{ØSO}_2\text{H} + \text{B} \underset{}{\overset{K_a}{\rightleftharpoons}} \text{ØSO}_2^- + \text{B}^+\text{H}$$





The rate expression derived for the postulated mechanism is

$$-\frac{dp}{dt} = \frac{k_2K_a}{H^+ + K_a}\,[T]\,[P]$$

where P = N-phenylmaleimide

T = total of $[\text{ØSO}_2^-] + [\text{ØSO}_2\text{H}]$

and K_2 = second order specific rate constant and

$$k_{obs} = \frac{k_2K_a}{H^+ + K_a}$$

or $\log k_{obs} = \log k_2K_a - \log(H^+ + K_a)$

It was found that, in high (H^+) concentration, the reaction depends upon the pH of the solution, i.e.

$$\log k_{obs} = \log k_2K_a + pH$$

and in low (H^+) concentration, the reaction depends upon the pK_a of benzenesulfinic acid, i.e.

$$\log k_{obs} = \log k_2K_a + pK_a$$

Microfilm $2.50; Xerox $4.80. 92 pages.

A STUDY OF THE TERNARY SYSTEM, DIOXANE-TETRAHYDROPYRAN-DINITROGEN TETROXIDE.

(L. C. Card No. Mic 59-5381)

Betty Jane Gibbins, Ph.D.
The Ohio State University, 1953

By constructing composition-temperature phase diagrams, Rubin, Sisler, and Shechter[1] found that 1,4-dioxane and tetrahydropyran form dinitrogen tetroxide addition compounds with different ether to dinitrogen tetroxide mole ratios and strikingly different melting points. $N_2O_4 \cdot O(CH_2CH_2)_2O$ melts at 45.2°C, whereas $N_2O_4 \cdot 2C_5H_{10}O$ melts at -56.8°C. These workers also established the fact that these compounds contain N_2O_4 units, not NO_2 radicals or NO^+, NO_2^+, NO_2^- or NO_3^- ions. A bicyclic monomer and a polymeric aggregation were suggested as possible structures for the dioxane compound. A study of the ternary system N_2O_4-$O(CH_2CH_2)_2O$-$C_5H_{10}O$ was desired (1) to investigate the possibility of formation of a ternary compound, (2) to compare the stability of the dinitrogen tetroxide-dioxane compound with that of the dinitrogen tetroxide-tetrahydropyran compound over a large concentration range, and (3) to obtain information which might help to determine which, if either, of the proposed structures for the binary dioxane compound is correct.

It was proposed that a temperature-composition phase diagram for the ternary system be constructed. This was done by combining phase diagrams for systems containing varying amounts of dinitrogen tetroxide and mixtures of tetrahydropyran and dioxane in fixed mole ratios of 10/90, 20/80, 30/70, 40/60, 50/50, 60/40, 70/30, 80/20, 88/12, 90/10, 92/8, and 96/4. Diagrams were also constructed for portions of the systems containing varying amounts of dioxane and mixtures of tetrahydropyran and dinitrogen tetroxide in fixed mole ratios of 94.1/5.9, 91.8/8.2, 86.6/13.4, 77.2/22.8, 65.1/34.9, and 54.2/45.8.

Dioxane was purified by Fieser's method.[2] Dinitrogen tetroxide was purified by a method similar to that of Giauque and Kemp.[3] Tetrahydropyran was dried over sodium hydroxide pellets for two days and then fractionally distilled from sodium under a nitrogen atmosphere.

Freezing points were determined in an all-glass cell

equipped with two standard taper ground glass joints. With one inlet attached to a drying tube filled with phosphoric anhydride and sand, ether was introduced through a Lunge pipette ground to fit the second inlet. The amount of ether was determined by the loss in weight of the Lunge pipette.

When the freezing point cell was cooled with liquid nitrogen, gaseous dinitrogen tetroxide could be distilled into the cell at room temperature. The amount of dinitrogen tetroxide added was determined either by the loss in weight of the dinitrogen tetroxide transfer cell or by the gain in weight of the freezing point cell.

The mixtures were stirred by a glass stirrer equipped with an iron slug and actuated by an intermittent magnetic field produced by a solenoid around the neck of the freezing point cell.

The cooling rate was controlled at one to two degrees per minute by selecting different jackets and coolants. Liquid nitrogen, carbon tetrachloride-chloroform-dry ice mixtures, salt and ice, ice water, and air were used.

Time-temperature cooling curves were recorded with a Leeds and Northrup Micromax by means of a copper-constantan thermocouple immersed in petroleum ether in the well of the freezing point cell.

All freezing points were determined at least twice, and are believed to be accurate within $\pm 1.5^{\circ}$C.

The composition-temperature curves constructed contained one maximum and two binary eutectic points. The compositions and freezing points of the maxima are listed in Table 1. Table 2 contains the compositions and freezing points of the binary eutectic mixtures.

TABLE I

MAXIMA OF TEMPERATURE-COMPOSITION CURVES

System		Mole % N_2O_4	Maximum Temp., $^{\circ}$C.
10/90	$C_5H_{10}O/C_4H_8O_2$	50.0	43.5
20/80	"	50.0	40.0
30/70	"	50.0	37.0
40/60	"	50.0	31.75
50/50	"	50.0	28.5
60/40	"	46	22.75
70/30	"	45	16.5
80/20	"	44	8.25
88/12	"	42.5	-2.75
90/10	"	42.0	-6.25
92/8	"	41.0	-13.0
96/4	"	41.0	-29.25

Fig. 1 was constructed by plotting the compositions of these binary eutectic mixtures on the concentration triangle forming the base of the ternary phase diagram. It is a projection of the ternary diagram on the triangular base. The letters have the same significance as they do in Fig. 2.

The compositions of the ternary eutectic mixtures were determined from the intersections in Fig. 1. Their freezing points were obtained from plateaus in the experimental cooling curves. The compositions and freezing points are listed in Table 3.

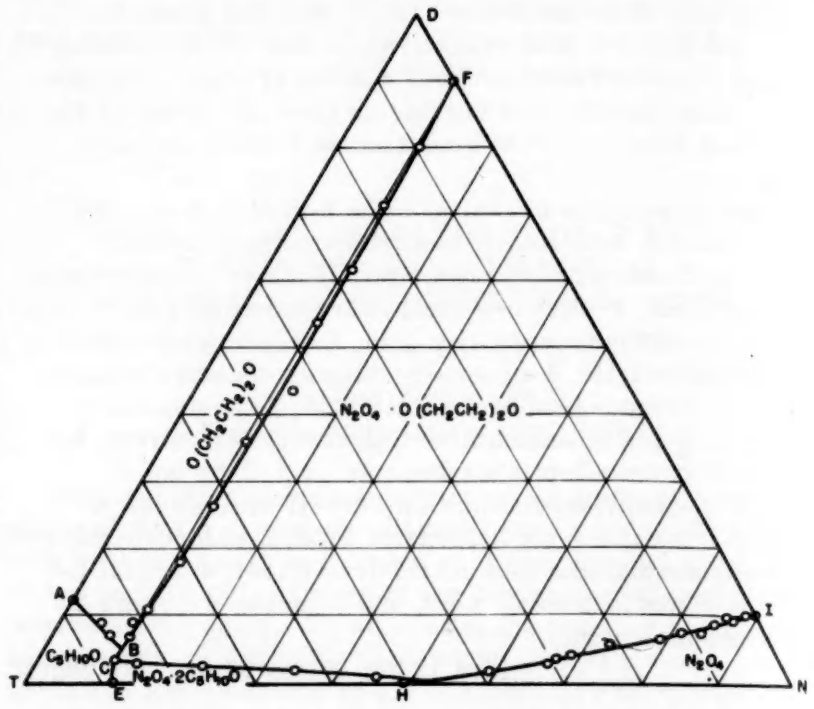


Fig. 1. Projection of the Phase Diagram on the Base.

TABLE II

BINARY EUTECTIC MIXTURES

System		Mole % N_2O_4	Freezing point, $^{\circ}$C.
10/90	$C_5H_{10}O/C_4H_8O_2$-N_2O_4	11.0	-0.5
10/90	"	89.0	-17.5
20/80	"	10.5	-4.25
20/80	"	88.0	-18.25
30/70	"	11.0	-9.0
30/70	"	86.0	-19.0
40/60	"	10.5	-14.0
40/60	"	85.0	-18.75
50/50	"	12.5	-20.0
50/50	"	84.0	-20.0
60/40	"	10.5	-24.5
60/40	"	81.5	-22.0
70/30	"	11.0	-32.0
70/30	"	79.0	-24.25
80/20	"	11.0	-48.75
80/20	"	73.0	-28.75
88/12	"	10.5	-66.0-67.0
88/12	"	68.5	-31.0
90/10	"	9.5	-86.0-90.0
90/10	"	66.5	-33.0
92/8	"	10.0	-86.5-90.0
92/8	"	66.5	-35.0
96/4	"	10.0	-88.0-90.0
96/4	"	59.5	-44.0
94.1/5.9	$C_5H_{10}O/N_2O_4$-$C_4H_8O_2$	8.8	-67.5
91.8/8.2	"	7.0	-74.5
86.6/13.4	"	2.8	-84.0
77.2/22.8	"	1.9	-67.5
65.1/34.9	"	1.2	-57.0
54.2/45.8	"	.7	-64.5

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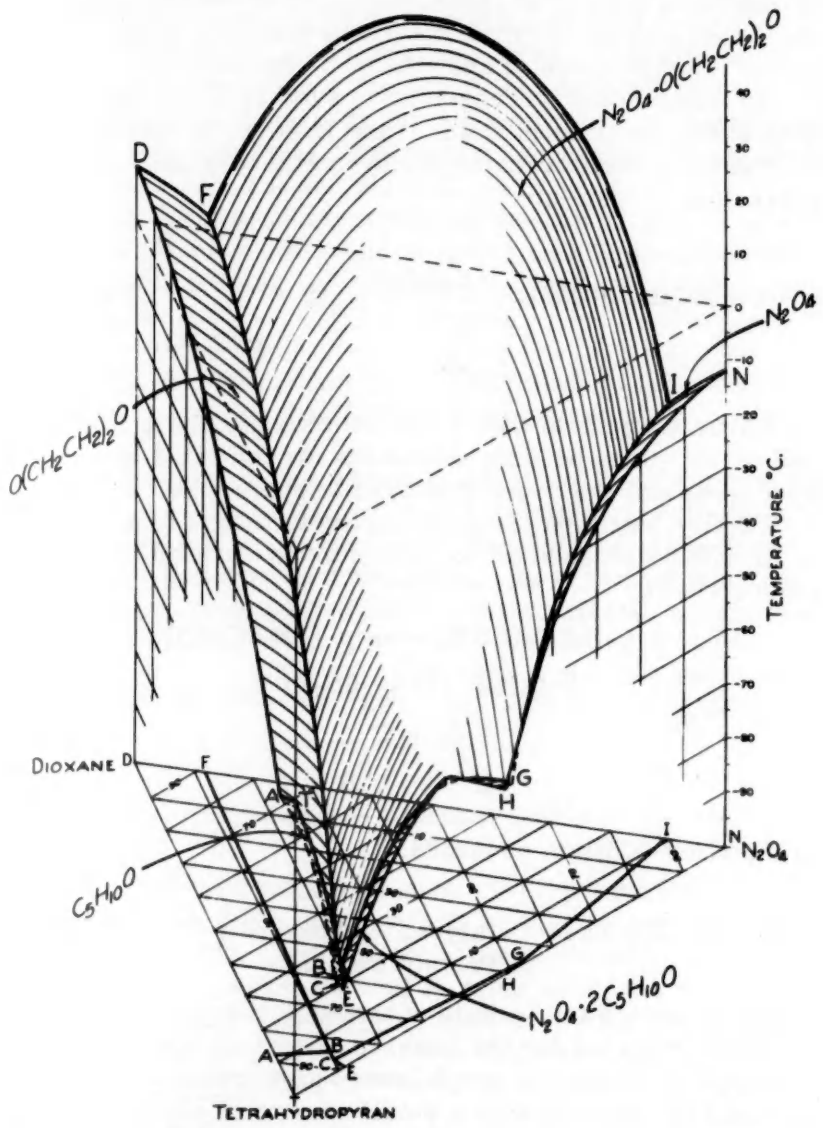


Fig. 2. The System Dioxane-Tetrahydropyran-Dinitrogen Tetroxide.

TABLE III

TERNARY EUTECTIC MIXTURES

Mole % Dioxane	Mole % Tetrahydropyran	Mole % Dinitrogen Tetroxide	Freezing point, °C.
5	85	10	-87.5 to -90.0
3	87	10	-87.5 to -90.0
0.25	47.75	52	-65.0 to -67.0

A three dimensional model of the ternary system was constructed by combining composition-temperature curves for the systems described with curves constructed by Rubin, Sisler, and Shechter[1] for the systems dioxane-dinitrogen tetroxide and tetrahydropyran-dinitrogen tetroxide and with the curve for the system dioxane-tetrahydropyran constructed by Dr. G. L. Eichhorn. A sketch of the ternary diagram is shown in Fig. 2. ABCET, DFBA, FIGC, INHB, and CGHE represent the surfaces of primary crystallization for tetrahydropyran, dioxane, dinitrogen tetroxide·dioxane, dinitrogen tetroxide, and dinitrogen tetroxide·2 tetrahydropyran, respectively.

The curves AB, FB, BC, CE, CG, HG, and GI represent the curves of binary eutectic crystallization for mixtures of tetrahydropyran and dioxane, dioxane and dinitrogen tetroxide·dioxane, tetrahydropyran and dinitrogen tetroxide·dioxane, tetrahydropyran and dinitrogen tetroxide·2 tetrahydropyran, dinitrogen tetroxide·dioxane and dinitrogen tetroxide·2 tetrahydropyran, dinitrogen tetroxide·2 tetrahydropyran and dinitrogen tetroxide, and dinitrogen tetroxide and dinitrogen tetroxide·dioxane, respectively. Points B, C, and G represent the ternary eutectic mixtures of dioxane, tetrahydropyran, and dinitrogen tetroxide·dioxane; of tetrahydropyran, dinitrogen tetroxide·dioxane, and dinitrogen tetroxide·2 tetrahydropyran; and of dinitrogen tetroxide, dinitrogen tetroxide·dioxane, and dinitrogen tetroxide·2 tetrahydropyran, respectively.

Figs. 1 and 2 indicate that there is no peak nor any slope change characteristic of a ternary compound with an incongruent melting point. Furthermore, the surface of primary crystallization for dinitrogen tetroxide·dioxane is by far the largest on the diagram, whereas that for dinitrogen tetroxide·2 tetrahydropyran is extremely small. There is a maximum at approximately 33 mole per cent dinitrogen tetroxide in the curve for the system tetrahydropyran-dinitrogen tetroxide and a maximum at 50 mole per cent dinitrogen tetroxide in the curve for the system dioxane-dinitrogen tetroxide.

These characteristics indicate the following facts: (1) There is no ternary compound stable at the conditions of this experiment, unless its surface of primary crystallization is so small that it is unimportant. (2) Over a wide concentration range the tendency of liquid dioxane to form a solid dinitrogen tetroxide addition compound is much greater than that of liquid tetrahydropyran. Thus the structures of the two crystalline compounds must be different, that of the dioxane compound being more stable. (3) Under the conditions of this experiment the only compounds formed are those with the empirical formulas $N_2O_4 \cdot 2C_5H_{10}O$ and $N_2O_4 \cdot O(CH_2CH_2)_2O$. Furthermore, viscosity and molecular weight determinations in the system N_2O_4-dioxane[4] have shown that the latter compound exists as a monomer at temperatures just above its melting point.

It is believed that each of the oxygen atoms in the 1,4-dioxane molecule, a Lewis base, shares one of its "lone pairs" of electrons with one of the nitrogen atoms of the dinitrogen tetroxide molecule, a Lewis acid. If the 1,4-dioxane molecule exists in the "boat" form, the "effective" oxygen to oxygen distance and the orientation of the orbitals occupied by a "lone pair" of electrons on each of the ether oxygen atoms is such that it appears reasonable that these orbitals can form bonds within two "pi" orbitals of the nitrogen atoms in the dinitrogen tetroxide molecule. If some rehybridization occurs at the nitrogen atoms, the "effective" O-O and N-N distances and the orientations of the bonding orbitals are even more favorable for the formation of such a bicyclic structure. It is, however, difficult to see how the "chair" form of the 1,4-dioxane molecule could form such a structure with dinitrogen tetroxide. Although electron diffraction data[5] indicate that free 1,4-dioxane exists in the "chair" form, it seems probable that the activation energy for the conversion is of about the same magnitude for 1,4-dioxane as for cyclohexane, and if this is true, the "chair" form of the 1,4-dioxane molecule could readily be converted to the "boat" form during compound formation.

It was suggested that the fact that tetrahydropyran does not form a stable addition compound with a tetrahydropyran to dinitrogen tetroxide mole ratio of one to one may be due

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to the fact that tetrahydropyran cannot act as a bidentate group and form such a bicyclic structure with dinitrogen tetroxide. It also was suggested that the fact that neither a stable dinitrogen tetroxide·2 dioxane nor a stable ternary compound is formed may be due to the high stability of the bicyclic structure for the compound dinitrogen tetroxide·dioxane. In such a structure there are no bonding orbitals on the nitrogen atoms available for coordinating a second ether molecule. Microfilm $2.50; Xerox $5.20. 103 pages.

1. Rubin, B., Sisler, H. H., and Shechter, H. "Molecular Addition Compounds of Dinitrogen Tetroxide with Several Aliphatic and Alicyclic Ethers," J. Am. Chem. Soc., 74 (1952), pp. 877-882.

2. Fieser, L. F. Experiments in Organic Chemistry. New York: D. C. Heath and Co., 1941, p. 368.

3. Giauque, W. F., and Kemp, J. D. "The Entropies of Nitrogen Tetroxide and Nitrogen Dioxide. The Heat Capacity from 5°K. to the Boiling Point. The Heat of Vaporization and the Vapor Pressure. The Equilibria $N_2O_4=2NO_2=2NO+O_2$," J. Chem. Phys., 6 (1938), pp. 40-52.

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5. Brockway, L. O., "Electron Diffraction by Gas Molecules," Rev. Modern Phys., 8 (1936), pp. 231-266.

Abstract published by special arrangement with The Ohio State University.

THE STEREOCHEMISTRY OF NUCLEOPHILIC ADDITIONS OF p-TOLUENETHIOL TO SUBSTITUTED ACETYLENES

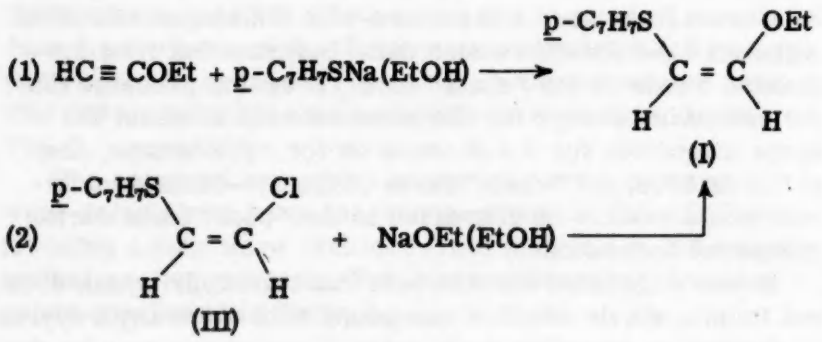
(L. C. Card No. Mic 59-4141)

David Lester Goldhamer, Ph.D.
Purdue University, 1959

Major Professor: William E. Truce

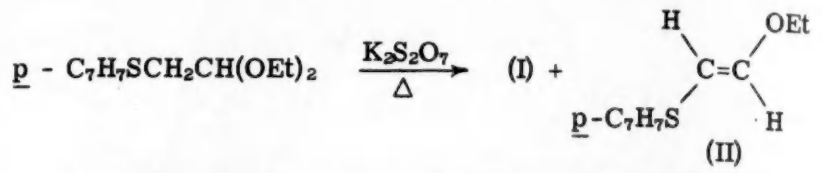
Part I. The Nucleophilic Addition of p-Toluenethiol to Ethoxyacetylene.

It has been demonstrated that nucleophilic additions of thiols to p-tolylmercaptoacetylene, phenyl ethynyl ketone, ethyl propiolate, phenylacetylene and chloroacetylene proceed in a stereoselective trans manner to form the cis product.[1a] The present investigation extends the Rule of trans-Nucleophilic Addition[1b] to the base-catalyzed addition of p-toluenethiol to ethoxyacetylene and of sodium ethoxide to p-tolylmercaptoacetylene formed in situ from cis-1-chloro-2-(p-tolylmercapto)-ethene (III), as outlined below.



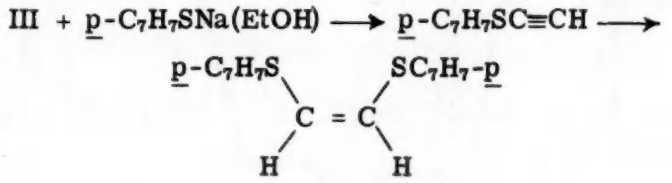
In reactions (1) and (2), cis-1-ethoxy-2-(p-tolylmercapto)-ethene (I) is formed by overall trans-addition of the elements of p-toluenethiol and ethanol respectively.

An independent stereoselective synthesis of I together with a smaller amount of the trans isomer, II, was effected by heating p-tolylmercapto diethylacetal with anhydrous potassium pyrosulfate.[2]



Infrared spectral data show the characteristic in-plane and out-of-plane bending vibrations for the cis-I-ethylenic hydrogens and the trans-II-ethylenic hydrogens.

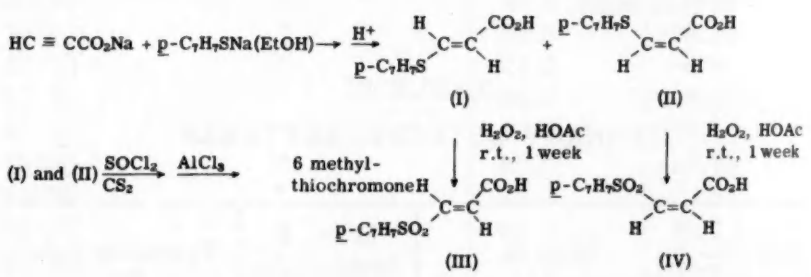
Finally, reaction (2) is analogous to that of treatment of III with p-toluenethiol to form cis-bis-(p-tolylmercapto)-ethene via an



elimination-addition sequence.[1a]

Part II. The Base-Catalyzed Addition of p-Toluenethiol to Propiolic Acid.

An exception to the Rule of trans-Nucleophilic Addition has been reported for the base-catalyzed addition of p-toluenethiol to sodium propiolate to give trans-p-tolylmercaptoacrylic acid (I) with a small amount of cis-p-tolylmercaptoacrylic acid (II) present.[1b] Additional evidence



for configurational assignments to I and II was investigated to confirm the anomalous cis-addition of p-toluenethiol to sodium propiolate.

Cyclization of I and II resulted in the more rapid formation of 6-methylthiochromone (V) from the acid assigned to the cis-structure. The cyclizations were carried out with carbon disulfide as the solvent to which thionyl chloride and the aluminum chloride were added while maintaining the temperature at 0°. The percent conversions to V from the cis-acid after 10 and 60 minutes were 71 and 85% respectively, while that from the trans-acid, after the same intervals, were 2.3 and 39% respectively.

Compounds I and II were oxidized to the corresponding trans and cis-p-tolylsulfonylacrylic acids, (III) and (IV). The following infrared spectral data gave good evidence for the geometric configuration of I and II based on their relative sulfones. Internal hydrogen bonding appears to be prevalent in the cis-isomer, IV, as observed by the

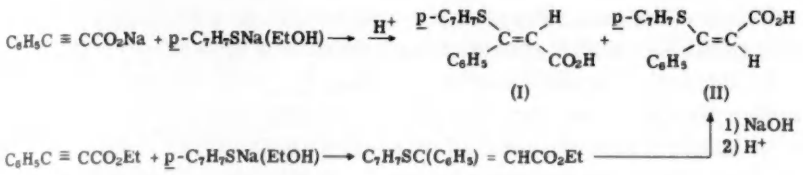
lowering of the carbonyl (C = O) stretching frequency by 45 cm.$^{-1}$ as compared to the trans-isomer, III.[3]

Dipole moment measurements of the sulfones in dioxane demonstrates that isomer IV has a dipole moment of 5.10 D whereas isomer III has a lower dipole moment of 4.39 D. A precision of 1% or better can readily be attained in moments of 1.5 D and higher.[4]

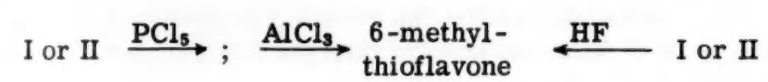
Based upon these experimental results II and IV are assigned the cis-configuration and I and III the opposite trans-configuration.

Part III. The Base-Catalyzed Addition of p-Toluenethiol to Sodium and Ethyl Phenylpropiolate.

p-Toluenethiol was added to ethyl phenylpropiolate to give, after saponification, trans-β-p-tolylmercaptocinnamic acid (II), in accord with the Rule of trans-Nucleophilic Addition to Acetylenes. However, a violation of this rule is observed when p-toluenethiol is added to



sodium phenylpropiolate to give cis-β-p-tolylmercaptocinnamic acid II together with a small amount of I. Treatment of I or II with phosphorus pentachloride followed by aluminum chloride as well as treatment with anhydrous liquid hydrogen fluoride resulted in the formation of one and the same product, 6-methylthioflavone (III), from each acid.

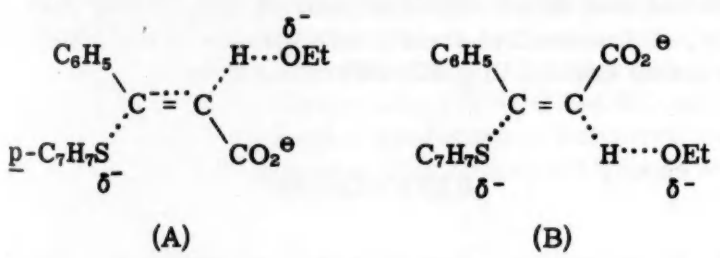


(III)

The driving force for overall conversion of I to III is presumably due to formation of a more stable ring system, and electrophilic attack on the more active ring system.[5]

The assignments of geometrical configurations to I and II were based on a series of dipole moment measurements. A greater differential and magnitude between dipole moments is observed when I and II are oxidized to the corresponding cis and trans-β-p-tolylsulfonylcinnamic acids.

The pattern of addition to sodium phenylpropiolate reverses itself due to the presence of the negatively charged carboxylate ion. The incipient bond formation of the thiol



would force a negative charge into the field of the carboxylate ion in (A), whereas the more favorable cis-addition involves the lower energetic interaction of two partial negative charges as depicted in (B).

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Microfilm $2.50; Xerox $6.40. 131 pages.

THE ANHYDROUS BROMINATION OF ETHYL p-t-BUTYL-β-CYANO-α-HYDROXYCINNAMATE

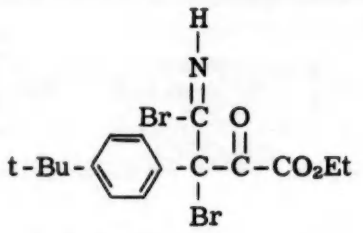
(L. C. Card No. Mic 59-5142)

George Robert Hartranft, Ph.D.
University of Delaware, 1959

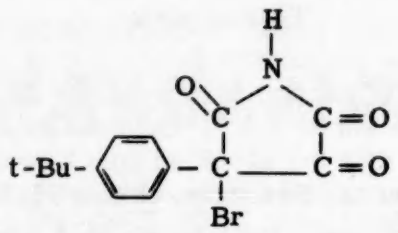
Supervisor: Glenn S. Skinner

The investigation of the reaction of dry bromine with ethyl p-t-butyl-β-cyano-α-hydroxycinnamate in anhydrous carbon tetrachloride has resulted in the isolation of two compounds containing bromine.

The first precipitated almost immediately from the reaction mixture. The analysis indicated that one mole of bromine had added to one mole of the starting ester. This reactive dibromide was converted to p-t-butylphenylhydroxymaleimide by the action of water or ethyl alcohol. p-t-Butylmandelic acid was obtained from the dibromide on aqueous alkaline hydrolysis. This dibromide was not a molecular complex of bromine with the ester as shown by the fact that removal of the bromine did not regenerate the starting ester. On the basis of these experimental facts, the following structure was proposed for the dibromide.



After removal of the precipitated dibromide, the second compound was isolated from the filtrate on standing at room temperature. This compound was considerably more stable than the dibromide. From subsequent investigation, this compound was shown to contain one bromine atom. Basic hydrolysis of this monobromide yielded p-t-butylmandelic acid. Reaction of the monobromide with hot toluene yielded p-t-butylphenylhydroxymaleimide and benzyl bromide. From this information the following structure was deduced for the monobromide.



The product formed by the removal of bromine from the dibromide by cyclohexene was shown to have the molecular formula $C_{30}H_{36}O_7N_2$. This unexpected result indicated that it was formed from two molecules of the starting ester. On the basis of its chemical and physical behavior, a structure was proposed for this compound.

The ethyl ether of the starting ester did not react to form either a mono or a dibromide. Moreover, it was converted to the ethyl ether of p-t-butylphenylhydroxymaleimide by alcoholic hydrogen chloride. It is thus apparent that the presence of an enolic hydrogen atom is necessary for the reaction with bromine.

Microfilm $2.50; Xerox $3.60. 62 pages.

THE ADDITION OF BROMINE ACETATE TO STYRENE AND SOME p-SUBSTITUTED STYRENES

(L. C. Card No. Mic 59-6606)

Howard Haubenstock, Ph.D.
University of Kansas, 1959

The reaction of styrene with bromine and silver acetate in dry carbon tetrachloride has been reported to give 1-phenyl-2-bromoethyl acetate (1). Since no direct evidence was presented for the absence of 2-phenyl-2-bromoethyl acetate, it was thought desirable to study this reaction further. The reactions of several p-substituted styrenes with bromine and silver acetate were also studied.

The preparation of 1-phenyl-2-bromoethyl acetate (I) and 2-phenyl-2-bromoethyl acetate (II) was necessary in order that the product of the reaction of styrene with bromine acetate might be analyzed directly with infrared. The following synthetic procedures were chosen:

(a) $C_6H_5\text{-}CO\text{-}CH_2Br \xrightarrow{NaBH_4} C_6H_5\text{-}CHOH\text{-}CH_2Br \xrightarrow{CH_3COCl} C_6H_5\text{-}CH(OCOCH_3)\text{-}CH_2Br$ (I)

(b) $C_6H_5\text{-}CH_2\text{-}COOH \xrightarrow[2.\ C_2H_5OH]{1.\ Br_2+P} C_6H_5\text{-}CHBr\text{-}COOC_2H_5 \xrightarrow[AlCl_3]{NaBH_4} C_6H_5\text{-}CHBr\text{-}CH_2OH \xrightarrow{CH_3COCl} C_6H_5\text{-}CHBr\text{-}CH_2OCOCH_3$ (II)

It was found, however, that the product of reaction scheme (a) and the product of reaction scheme (b) had essentially identical infrared spectra. Reduction of each of the above products to the halogen-free alcohols with lithium aluminum hydride-lithium hydride, followed by infrared analysis gave the following results:

(I) $\xrightarrow[\text{Tetrahydrofuran}]{LiAlH_4\text{-}LiH}$ $C_6H_5\text{-}CHOH\text{-}CH_3$ (64%) + $C_6H_5\text{-}CH_2CH_2OH$ (36%)

(II) $\xrightarrow[\text{Tetrahydrofuran}]{LiAlH_4\text{-}LiH}$ $C_6H_5\text{-}CHOH\text{-}CH_3$ (53%) + $C_6H_5\text{-}CH_2CH_2OH$ (47%)

These analyses refer only to the composition of the fractions which were reduced. The fraction chosen for reduction in each case represented a major portion of the product and had been analyzed for elemental composition. The results were supported by qualitative gas chromatographic analysis. Rearrangement, clearly, had occurred in one or more steps of the synthetic scheme to give a mixture of bromoacetates, and/or during the lithium aluminum hydride-lithium hydride reduction resulting in a mixture of 1-phenylethanol and 2-phenylethanol. On further study it was established by infrared and gas chromatographic analysis that rearrangement actually occurred during the distillation of the styrene bromoacetates (I and II) and presumably also during the acetylation step if the reaction mixture was sufficiently heated. Such thermal rearrangements of haloesters have been described (2).

The reaction of styrene with bromine acetate was studied under the following conditions: (a) the reaction product was distilled and a major fraction was reduced with lithium aluminum hydride-lithium hydride, (b) the crude reaction product was not distilled but was directly reduced with lithium aluminum hydride-lithium hydride. When the styrene bromoacetate was distilled, the reduction product was found to consist of a mixture of 1-phenylethanol and 2-phenylethanol (by infrared and gas chromatographic analysis). When the crude styrene bromoacetate was reduced directly, no 2-phenylethanol was found. It may be concluded that the reaction of styrene with bromine and silver acetate (involving bromine acetate as an intermediate) yields 1-phenyl-2-bromoethyl acetate (I) with no detectable amount of 2-phenyl-2-bromoethyl acetate (II).

The results obtained in the reaction of p-substituted styrenes with bromine acetate may be summarized by the following equation:

$$p\text{-}X\text{-}C_6H_4\text{-}CH=CH_2 + Br_2 + AgOCOCH_3 \longrightarrow p\text{-}X\text{-}C_6H_4\text{-}CH(OCOCH_3)\text{-}CH_2Br + AgBr$$

X = CH_3, Cl

The bromoacetates in both of these cases were not distilled, but were reduced directly with lithium aluminum hydride-lithium hydride. The reduction products were analyzed by gas chromatography.

The addition of bromine acetate to p-nitrostyrene was investigated. The infrared spectrum of the addition reaction product was compared with those of 1-(p-nitrophenyl)-2-bromoethyl acetate and 2-(p-nitrophenyl)-2-bromoethyl acetate (crude). On the basis of this comparison it was concluded that only a small amount, if any, of 2-(p-nitrophenyl)-2-bromoethyl acetate was formed in the addition of bromine acetate to p-nitrostyrene.

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Microfilm $2.50; Xerox $5.60. 111 pages.

SYNTHESIS AND PROPERTIES OF PYRIDOXAL ANALOGS

(L. C. Card No. Mic 59-6177)

Dietrich Heinert, Ph.D.
Clark University, 1959

Supervisor: Arthur E. Martell

Infrared spectra of pyridinecarboxaldehydes, o-methoxypyridinecarboxaldehydes, and o-hydroxypyridinecarboxaldehydes and of the corresponding substituted benzaldehydes are reported for the solid and liquid states and for dilute carbon tetrachloride solutions. Evidence is given that intramolecular hydrogen bonding exists in 3-hydroxy-4-pyridinecarboxaldehyde and 3-hydroxy-2-pyridinecarboxaldehyde in the liquid state and in solution, and the strength of chelation is correlated to the bond order in pyridine. Intermolecular hydrogen bonding is shown to occur in the crystalline 3-hydroxypyridinecarboxaldehydes, 3-pyridol, and pyridoxal and a proposal for the structure of these substances is made accordingly. Improved methods are described for the synthesis and the purification of hydroxy- and methoxypyridinecarboxaldehydes. Crystalline Schiff Bases were prepared from hydroxypyridinecarboxaldehydes and various amino acids and amino compounds. The visible and ultraviolet absorption spectra of these products were measured in methanol solution. The results indicate that Schiff Bases of this type are actually formed as intermediates in transamination experiments.

Microfilm $2.50; Xerox $5.20. 102 pages.

PROBLEMS IN THE SYNTHESIS OF TRIFLUOROMETHYL-BUTADIENES

(L. C. Card No. Mic 59-5384)

Paul Eugene Hinkamp II, Ph.D.
The Ohio State University, 1953

The successful polymerization of $CF_2=CF_2$ and $CF_2=CFCl$ to commercially useful polymers of extreme thermal stability, chemical inertness, and resistance to solution or swelling in solvents has stimulated interest in research for more fluorinated monomers.

Copolymerization of other substances with $CF_2=CF_2$ and $CF_2=CFCl$, while generally unsatisfactory, gave the best results with butadiene. To eliminate copolymerization difficulties, synthesis of butadiene systems with a fluorinated group attached has been attempted.

The synthesis of three monomers, 1-trifluoromethyl-1,3-butadiene, $CF_3CH=CHCH=CH_2$; 1-trifluoromethyl-3-methyl-1,3-butadiene, $CF_3CH=CHC(CH_3)=CH_2$; and 2-trifluoromethyl-1,3-butadiene, $CH_2=C(CF_3)CH=CH_2$, has been carried out. Attempted syntheses of butadiene systems containing two attached trifluoromethyl groups were unsuccessful.

Synthesis of 1-Trifluoromethyl-1,3-butadiene

Trifluoroacetylacetone, $CF_3COCH_2COCH_3$,[1] was hydrogenated to the diol $CF_3CHOHCH_2CHOHCH_3$ on Raney nickel. Dehydration attempts with phosphorus pentoxide or thionyl chloride were unsuccessful. Concentrated sulfuric acid gave low yields and polymers. Pyrolysis of the diacetate $CF_3CHOAcCH_2CHOAcCH_3$[2] gave $CF_3CH=CHCH=CH_2$, b. 45-46°, maleic anhydride adduct m. 93.5-94.5°.

Synthesis of 1-Trifluoromethyl-3-methyl-1,3-butadiene

When trifluoroacetylacetone, $CF_3COCH_2COCH_3$, was treated with one equivalent of CH_3MgBr, methane was evolved and hydrolysis regenerated the diketone. The inverse addition of two equivalents of CH_3MgBr to trifluoroacetylacetone first formed the enol salt with evolution of methane; then normal addition to the remaining carbonyl group occurred, producing an alcohol which was easily dehydrated with acid catalysis to a compound assumed to be $CF_3COCH=C(CH_3)_2$.

$$CF_3COCH_2COCH_3 \xrightarrow{CH_3MgBr} CF_3\overset{\overset{OMgBr}{|}}{C}=CHCOCH_3 \xrightarrow{CH_3MgBr}$$

$$BrMgO\,OMgBr \quad\quad OH$$
$$CF_3\text{-}\overset{|}{C}=CH\overset{|}{C}CH_3 \xrightarrow{+\,2\,H_2O} CF_3COCH_2\overset{|}{C}CH_3 \xrightarrow{-H_2O}$$
$$CH_3 \quad\quad CH_3$$

$$CF_3COCH=C(CH_3)_2$$

One-four addition to the $-\overset{|}{C}=CH-\overset{\|}{C}-$ conjugated system of the enol or addition to the carbonyl adjacent to the CF_3 group did not occur since a tertiary alcohol of the $CF_3CHOHCH_2R$ type, which is characterized by very difficult dehydration, did not form.

$CF_3COCH=C(CH_3)_2$ was reduced by Meerwein-Pondorf-Verley reduction to $CF_3CHOHCH=C(CH_3)_2$, which was simultaneously dehydrated and rearranged, by pyrolysis of its acetate, to $CF_3CH=CHC(CH_3)=CH_2$, b. 74-75°, maleic anhydride adduct m. 127-128°.

Synthesis of 2-Trifluoromethyl-1,3-butadiene

Previous workers[3] have reported the synthesis of $CH_2=C(CF_3)CH=CH_2$ by the following route:

$$CF_3COCH_3 \xrightarrow[2.\ H_2O]{1.\ HC\equiv CMgX} CF_3\text{-}\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}\text{-}C\equiv CH \longrightarrow CH_2=\overset{\overset{|}{C}F_3}{C}\text{-}C\equiv CH$$

$$\xrightarrow{+\,H_2} CH_2=\overset{\overset{|}{C}F_3}{C}\text{-}CH=CH_2$$

This synthesis could not be repeated because the dimagnesium salt of acetylene, $BrMgC\equiv CMgBr$, formed in preference to the monomagnesium salt, $HC\equiv CMgBr$, in spite of claims to the contrary.[3,4]

The synthesis of $CH_2=C(CF_3)CH=CH_2$ was accomplished by the following route:

$$CF_3COCH_3 \xrightarrow[2.\ H_2O]{1.\ C_2H_5MgBr} CH_3\text{-}\overset{\overset{OH}{|}}{\underset{\underset{CF_3}{|}}{C}}\text{-}C_2H_5 \xrightarrow[2.\ Pyrolyze]{1.\ Ac_2O}$$

$$\left\{\begin{matrix} CH_2=C(CF_3)C_2H_5 \\ CH_3C(CF_3)=CHCH_3 \end{matrix}\right\} \xrightarrow[succinimide]{N\text{-}Bromo\text{-}} \left\{\begin{matrix} CH_2=C(CF_3)CHBrCH_3 \\ CH_2BrC(CF_3)=CHCH_3 \\ CH_3C(CF_3)=CHCH_2Br \end{matrix}\right\}$$

$$\xrightarrow[amine]{triethyl\text{-}} CH_2=C(CF_3)CH=CH_2$$

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The reaction of ethyl Grignard with trifluoroacetone gave partial reduction to $CF_3CHOHCH_3$ as well as normal addition to $CH_3C(CF_3)(OH)C_2H_5$. The acetate pyrolysis of $CH_3C(CF_3)(OAc)C_2H_5$ produced two isomers which were not separated. Allylic bromination then produced three isomers which were subjected without isolation to dehydrohalogenation with triethyl amine to give $CH_2=C(CF_3)CH=CH_2$, b. 34°–35°, maleic anhydride adduct m. 107°–107.5°.

Attempted Preparation of 1,4-bis(trifluoromethyl)-1,3-butadiene

The following synthetic route to $CF_3CH=CHCH=CHCF_3$ was attempted:

$$(CF_3COCHCOOEt)^-Na^+ \xrightarrow{I_2} \begin{matrix} CF_3COCHCOOEt \\ | \\ CF_3COCHCOOEt \end{matrix} \xrightarrow{H^+}$$

$$CF_3COCH_2CH_2COCF_3 \xrightarrow{H_2} CF_3CHOHCH_2CH_2CHOHCF_3$$

$$\xrightarrow[2.\ \text{Pyrolyze}]{1.\ Ac_2O} CF_3CH=CHCH=CHCF_3$$

This synthesis failed when the coupling reaction which was to be produced by the iodine gave extensive iodination and produced iodoform and unidentified decomposition products.

An attempt was then made to use the synthetic route shown below:

$$CF_3CH_2COOEt \xrightarrow[2.\ H_2O]{1.\ Na} CF_3CH_2CHOHCOCH_2CF_3 \xrightarrow{H_2}$$

$$CF_3CH_2CHOHCHOHCH_2CF_3 \xrightarrow{H^+} CF_3CH=CHCH=CHCF_3$$

β-Trifluoropropionic acid was prepared[5] and esterified with ethanol. The ester was then used in an attempted acyloin condensation. Dehydrohalogenation with loss of hydrogen fluoride occurred when the ester was treated with sodium, and none of the expected product was isolated.

Attempted Preparation of 2,3-bis(Trifluoromethyl)-1,3-butadiene

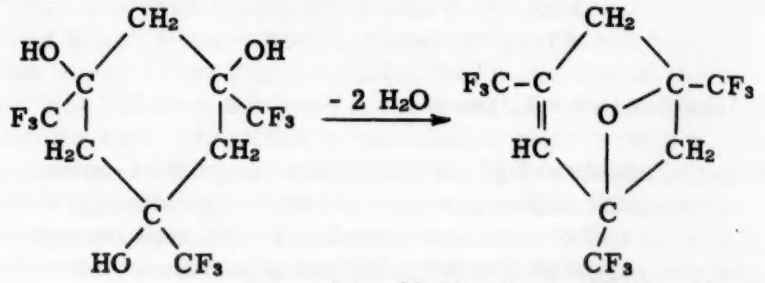
Synthesis of $CH_2=C(CF_3)C(CF_3)=CH_2$ was attempted by the synthetic route outlined below:

$$CF_3COCH_3 \xrightarrow[2.\ H_2O]{1.\ Na} CF_3\text{-}\overset{HO}{\overset{|}{C}}(CH_3)\text{-}\overset{OH}{\overset{|}{C}}(CH_3)\text{-}CF_3 \xrightarrow[2.\ \text{Pyrolyze}]{1.\ Ac_2O}$$

$$CH_2=\overset{F_3C}{\overset{|}{C}}\text{-}\overset{CF_3}{\overset{|}{C}}=CH_2$$

Amalgamated magnesium and trifluoroacetone gave no reaction. When trifluoroacetone was dropped on sodium at ice-bath temperature, a solid developed which was first thought to be the desired di-sodium salt of the pinacol. The theoretical amount of sodium was not used, however, and it became obvious that the reaction had taken a different course. The solid was hydrolyzed and recrystallized from hot benzene, giving material m. 93–100°, which exhibited a molecular weight of 338.

Dehydration of the solid with either phosphorus pentoxide or concentrated sulfuric acid gave a liquid, b. 119–120°, of molecular weight 296 which absorbs two moles of hydrogen per mole of unknown, and gives a bright red color with aluminum chloride and chloroform. The following structures are proposed for the solid and the liquid produced by the dehydration reaction:



Microfilm $2.50; Xerox $3.80. 66 pages.

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Abstract published by special arrangement with The Ohio State University.

A TRACER STUDY ON THE MECHANISM OF THE PINACOL-PINACOLONE REARRANGEMENT USING CARBON-14

(L. C. Card No. Mic 59-5554)

Robert Louis Holt, Ph.D.
The University of North Carolina, 1959

Supervisor: Arthur Roe

The synthesis of two unsymmetrical pinacols, Pinacol I (1,1-diphenyl-2-methyl-1,2-dihydroxy-3-pentene-5-C^{14}) and Pinacol II (1,1-diphenyl-2-methyl-1,2-dihydroxy-4-pentene-3 (and 5)-C^{14}), are described.

A study of the rearrangement of Pinacols I and II using carbon-14 as a tracer was undertaken to determine whether an inversion in the position of carbon-14 would occur during the reaction. If no inversion occurred a 3-membered cyclic intermediate or 1-2 shift would be favored. Inversion of the position of carbon-14 would favor a 4-membered cyclic intermediate in the case of Pinacol I and a 5-membered cyclic intermediate in the case of Pinacol II.

Pinacols I and II were ozonized and the radioactivity of the fragments measured. The pinacols were then rearranged to Pinacolones I and II by five different acid media, ozonized and the radioactivity of these fragments determined.

The migrating propenyl group in Pinacol I showed no inversion of position of carbon-14 suggesting the possibility of a 3-membered cyclic intermediate in the reaction.

No inversion of carbon-14 position occurred in the case of Pinacol II where the migrating entity was an

allyl group again suggesting the possibility of a 3-membered cyclic intermediate.

Microfilm $2.50; Xerox $3.60. 64 pages.

RINGCLOSURES VIA BENZYNE INTERMEDIATES

(L. C. Card No. Mic 59-5555)

Bjorn Frederick Hrutfiord, Ph.D.
The University of North Carolina, 1959

Supervisor: J. F. Bunnett

PART I

A new principle for the synthesis of fused ring systems has been originated and developed. This promises to be one of the most powerful methods of ringclosure ever made available to the organic chemist. It is conceivably applicable to the synthesis of homocyclic and heterocyclic rings of any reasonable size, known and unknown. Hetero atoms may occupy almost any position in the ring. Furthermore, through appropriate choice of reactants, it is often possible to synthesize a given ring system in different states of unsaturation or oxidation. The method is not without limitations; some of the limitations have been defined.

The new principle of synthesis involves ringclosure via benzyne intermediates. Such intermediates have a nucleophilic center, located in a side chain, which can add intramolecularly to the "triple bond" of the benzyne to form the new ring. The ringclosure is brought about by the action of potassium amide in liquid ammonia, which generates both the nucleophilic center and the benzyne intermediate. An example of the reaction is the conversion of thiobenz(o-bromo)anilide to 2-phenylbenzothiazole in a 90% yield. This reaction proceeds via a benzyne intermediate which has a thiobenzamide side chain in the thioenolate form. In agreement with the expected mechanism, 2-phenylbenzothiazole was also formed from thiobenz(m-bromo)anilide (in 68% yield).

The synthesis of benzothiazole, benzoxazole, indole, oxindole and phenothiazine ring systems in generally good yields (45-90%) has been accomplished by this method. These examples include the formation of five- and six-membered heterocyclic rings which contain one or two hetero atoms. The adding reagent has been nucleophilic sulfur, nitrogen, carbon, and oxygen. The successful use of oxygen indicates that even weak nucleophilic reagents in the side chain may be effective in this kind of ringclosure.

Several compounds failed to undergo the expected ringclosure. In these cases it was possible for a dianion to be formed in which a negative charge was localized on an atom alpha to the haloaryl ring. This is believed to prevent the formation of the benzyne intermediate.

PART II

The cleavage of ortho-halobenzophenones by the action of potassium amide in liquid ammonia has been investigated. Following the discovery that 2-chloro-2',5'-dimethylbenzophenone is cleaved by this reagent with formation of aniline and 2,5-dimethylbenzamide, several other ortho-halobenzophenones were prepared and treated with potassium amide. The products were always a benzamide and an aniline except in the case of ortho-fluorobenzophenone, which gave fluorobenzene rather than aniline.

The results are consistent with a mechanism in which the benzophenone is first cleaved with formation of the benzamide and an ortho-halophenyl anion. This anion then goes on to form a benzyne which in turn is aminated to form the aniline. Fluorobenzene, although it exchanges ortho-deuterium rapidly, is not converted to aniline under similar reaction conditions. Thus fluorobenzene is the expected product of a stepwise cleavage.

The cleavage was proven to be stepwise by the reaction of 2-chloro-4-methylbenzophenone with potassium amide in liquid ammonia. In this case a concerted cleavage with direct formation of a benzyne would give 4-methylbenzyne, which can yield only meta- and para-toluidine. The 2-chloro-4-methylphenyl anion resulting from a stepwise cleavage may lose chloride ion to form 4-methylbenzyne, or may react with the solvent to give meta-chlorotoluene. This compound will yield ortho-, meta-, and para-toluidine under the reaction conditions. An appreciable amount of ortho-toluidine was identified among the reaction products, thus proving a stepwise cleavage.

The cleavage reaction is activated by halogens in the order ortho >> meta > para. With meta- and para-chlorobenzophenones, the cleavage reaction is subordinate to amination reactions, involving benzyne intermediates, which yield aminobenzophenones.

Microfilm $2.50; Xerox $7.40. 158 pages.

BICYCLO/2.2.1/HEPTANE- AND BICYCLO/2.2.2/OCTANE-2,3-DIAMINE

(L. C. Card No. Mic 59-6178)

Criton Socrates Inglessis, Ph.D.
Clark University, 1959

Supervisor: Arthur E. Martell

The Diels-Alder adducts endo-bicyclo/2.2.1/5-heptene-2,3-dicarboxylic anhydride (I) and endo-bicyclo/2.2.2/5-octene-2,3-dicarboxylic anhydride (II), were converted through the Curtius reaction to trans-bicyclo/2.2.1/heptane-2,3-diamine dihydrochloride (III) and trans-bicyclo/2.2.2/octane-2,3-diamine dihydrochloride (IV) respectively.

The saturated esters of I and II produced with excess hydrazine hydrate, trans-bicyclo/2.2.1/heptane-2,3-dicarbohydrazide (V) and trans-bicyclo/2.2.2/octane-2,3-dicarbohydrazide (VI) respectively, which were smoothly rearranged to the corresponding benzyl carbamates. Hydrolysis of the latter yielded III and IV. 7-Oxa-bicyclo/2.2.1/heptane-2,3-dicarbohydrazide could not be synthesized by this method. I, II, their saturated analogs and dimethyl exo-7-oxa-bicyclo/2.2.1/heptane-2,3-dicarboxylate gave upon reaction with hydrazine hydrate the corresponding N-aminoimides. In general the reaction of vicinal dicarboxylic anhydrides and their esters with hydrazine hydrate to produce dicarbohydrazides, N-aminoimides or pyridazinediones, is examined.

The NNN'N-tetracyanomethylene and NNN'N-tetraacetic acid derivatives of III and IV, as well as disalicylidene Schiff bases of III, IV, V and VI were also synthesized.

The principal infrared absorptions of these compounds are presented and discussed.

Microfilm $2.50; Xerox $3.80. 66 pages.

SYNTHESIS OF UNIFORM LATEXES

(L. C. Card No. Mic 59-5985)

Andrew H. Loranger, Ph.D.
Case Institute of Technology, 1958

Presuming that the modern theory of emulsion polymerization is correct, some implications of the theory were deduced, which predict that control of soap type, concentration, and manner of addition should produce latexes of homogeneous particle size. These deductions were confirmed through the development of several recipes which produced uniform latexes of polystyrene and butadiene-styrene copolymer.

Experiments with lithium soap types of recipes were especially successful in producing very uniform latexes. However, the results obtained with lithium soaps conformed less with the predictions of the theory than was the case for other soaps which are used more commonly in emulsion polymerization recipes.

Microfilm $2.50; Xerox $5.20. 103 pages.

THE CHEMISTRY OF SOME 8-SUBSTITUTED CAFFEINES

(L. C. Card No. Mic 59-6068)

Joseph B. Mettalia, Jr., Ph.D.
University of Cincinnati, 1959

A number of 8-substituted caffeines were synthesized for evaluation as cancer chemotherapeutic agents. During the course of this work some new and interesting knowledge of the chemistry of 8-substituted caffeines was obtained.

The following new compounds were prepared: 8-propylaminocaffeine, 8-isopropylaminocaffeine, 8-butylaminocaffeine, 8-sec-butylaminocaffeine, 8-hexylaminocaffeine, 8-tert-butylaminomethylcaffeine, N,N'-di(8-caffeinyl) ethylenediamine, N-(8-caffeinyl)p-phenylenediamine, 8-(N-nitroso-N-ethyl)aminocaffeine, 8-(N-nitroso-N-butyl) aminocaffeine, 8-(N-nitroso-N-hexyl)aminocaffeine, N,N'-dinitroso-N,N'-di(8-caffeinyl)ethylenediamine, 1,2-bis (8-caffeinylazo)ethane, 8-(β-hydroxyethylamino)caffeine, 2,2-diethoxy-N-(8-caffeinyl)ethylamine and 8-(p-nitrobenzal)aminocaffeine.

The 8-alkylaminocaffeines were prepared by reacting 8-bromocaffeine with primary amines. It was found that the yields decreased with increased branching of the α-carbon atom of the primary amine. That this was due to a steric repulsion between the imidazole ring of caffeine and the alkyl group of the amine was indicated by the fact that tert-butylamine did not react with 8-bromocaffeine or 8-bromotheopylline (theophylline differs from caffeine in that it lacks a methyl group on the 7 position) but did react with 8-chloromethylcaffeine. It was also found that the N-nitrosamines which were prepared were quite unstable. This instability could be due to the structural similarity of these N-nitrosamines to N-nitrosoamides which are known to undergo rearrangements.

A new synthesis of 8-aminocaffeine was achieved by means of a Gabriel reaction. 8-Aminocaffeine was also obtained unexpectedly from the decomposition of 2,2-diethoxy-N-(8-caffeinyl)ethylamine in acid solution and from the decomposition of 8-caffeinylhydrazine in dimethylformamide and phenol solutions.

A study of the ultraviolet absorption spectra and the infrared spectra of some 8-substituted caffeines shed some light on the tautomerism of 8-aminocaffeine and the structure of 8-(N-substituted)aminocaffeines. It was found that 8-aminocaffeine possesses a triplet peak in the N-H and OH region of the infrared. This was interpreted as indicating the existence of a tautomeric equilibrium. The ultraviolet absorption spectra eliminated the possibility that the 8-(N-substituted)aminocaffeines were actually substituted at the 9-position but it did not give a definite answer to the question of whether a tautomerism actually occurs. Microfilm $2.50; Xerox $4.60. 87 pages.

THE EFFECTS OF TRANSANNULAR SUBSTITUENTS ON THE RATE OF ADDITION OF 2,4-DINITROBENZENESULFENYL CHLORIDE TO CYCLOHEXENES AND NORBORNENES

(L. C. Card No. Mic 59-5144)

Leroy Jesse Miller, Ph.D.
University of Delaware, 1959

Supervisor: Harold Kwart

The rates of addition of 2,4-dinitrobenzenesulfenyl chloride to a series of 4-monosubstituted and cis-4,5-disubstituted cyclohexenes and 5-monosubstituted and cis-5,6-disubstituted norbornenes, as well as the more sterically hindered olefin, bornylene, were determined in glacial acetic acid at 30.1° C.

The rates of addition to the monosubstituted cyclohexenes were correlated by means of the equation

$$\log k/k_o = \sigma_I \rho_I$$

where k is the rate constant for the reaction of a given compound; k_o is the rate constant for the reaction of some standard compound (in this case cyclohexene); σ_I is a constant characteristic of the inductive effect of the substituent; and ρ_I is a constant for the reaction. The effects of a second transannular substituent in a cis-4,5-disubstituted cyclohexene were not strictly comparable to the first. Explanations based on the enforced axial disposition of the second substituent in the modified chair conformation of cyclohexene were advanced.

The effects of substituents in the norbornene series were found to be similar to the effects of the same substituents in the cyclohexene series. The enhanced effect of endo- as compared to exo-substituents was discussed in the light of investigations of field effects reported in the literature. Steric hindrance in bornylene was manifested

by a substantially slower reaction than that observed for norbornene.

The rate-retarding effect of transannular methyl groups was discussed without conclusion.

Microfilm $2.50; Xerox $5,80. 118 pages.

STRUCTURAL STUDIES ON ROOT BARK PIGMENTS OF THE OSAGE ORANGE

(L. C. Card No. Mic 59-5365)

Percy Meldrum Mundell, Ph.D.
The Ohio State University, 1953

Previous publications by McWain,[1] Looker,[2] Thompson,[3] and Wolfrom,[4] described the isolation of three yellow pigments (designated as Substances I, II, and III) from the root bark of the Osage Orange (Maclura pomifera Raf.). Complete references and experimental details for the isolation and partial characterization of Substances I and II are given in Looker's dissertation.[2] The report by Thompson[3] summarizes the isolation and partial characterization of Substance III.

Substance I, $C_{23}H_{22}O_6$, was shown to be dimorphous and formed a 1:1 pyridine complex. Stepwise acetylation and methylation produced di- and tri-derivatives. Catalytic hydrogenation proceeded stepwise to di- and tetrahydro-derivatives without formation of new hydroxyl groups. The double bonds were shown to be neither conjugated (no addition product with maleic anhydride) to each other nor to a benzene ring (ultraviolet). On the basis of the above data and specific color tests, Looker depicted the partial structural formula (Figure 1) for Substance I. At least part of

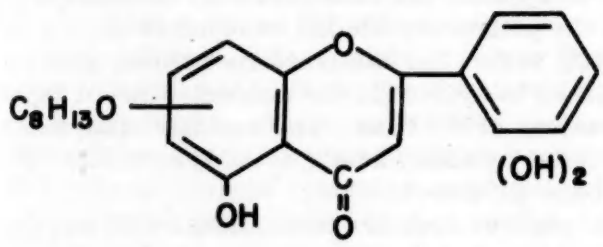


Figure 1

the $C_8H_{13}O$- group was believed to be attached at position six of the phenylchromone system. Tentative evidence placed the two hydroxyl groups on the side phenyl group as ortho to each other.

Substance II, $C_{18}H_{14}O_5$, was isolated from the root bark in only a very small amount. It was acetylated and methylated to give a diacetate and a dimethyl ether. On the basis of these data and specific color tests, Looker depicted the partial structural formula (Figure 2) for Substance II.

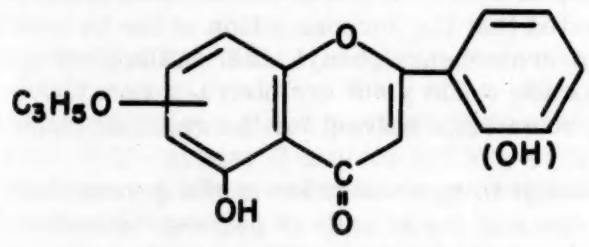


Figure 2

Substance III, $C_{23}H_{22-24}O_6$, proved to be somewhat unstable and became highly colored upon standing. It was readily acetylated and methylated to form a triacetate and a trimethyl ether. The same derivative was obtained upon mild, vigorous or reductive acetylation. No attempt was made to assign a partial structural formula to Substance III.

The object of the present investigation was to further elucidate the structures of Substances I and III. The total available quantity of Substance II was insufficient to permit degradative studies of that pigment.

The X-ray powder diffraction patterns of Substances I (high melting dimorph), II, and III have been measured. All data were obtained with CuK_α radiation, $\lambda = 1.5418$ Å., exposure time as indicated. The first figure is the d spacing in Å. The second figure is the relative intensity as estimated visually: if parenthetically expressed, it denotes the most intense lines in decreasing order of intensity. Substance I (high melting dimorph), $C_{23}H_{22}O_6$; exposure time 1.25 hours. 8.33, 7.38, 5.81(3), 5.04, 4.52(2), 3.93(5), 3.65(1), 3.26(4), 2.99, 2.75, 2.53, 2.28, 2.18, 2.04, 1.81, 1.38, 1.23, 1.18. Substance II, $C_{18}H_{14}O_5$; exposure time 1 hour. 9.03, 5.84(1), 4.85, 4.26, 3.88, 3.45(2), 3.17(3), 2.92, 2.33, 2.09(4), 1.96, 1.81(5), 1.28, 1.09. Substance III, $C_{23}H_{22-24}O_6$; exposure time 1.25 hours. 9.39(4), 8.33(5), 5.93, 5.31(3), 4.75(2), 3.72, 3.38(1), 2.71, 2.17, 2.07, 1.72(6).

Hydrogenation of Substance I with platinic oxide in glacial acetic acid produced tetrahydro-Substance I. This product was shown to be dimorphous with the tetrahydro-Substance I obtained by Looker.[2] This fact was established by the use of X-ray powder diffraction measurements, color tests, and spectrographic analyses.

Tetrahydro-Substance I trimethyl ether was recovered in 75 per cent yield from an attempted oxidation of the material with alkaline peroxide. This result indicated that the postulated γ-pyrone ring in tetrahydro-Substance I trimethyl ether remained intact during the reaction. This high stability to alkaline peroxide is characteristic of flavones.

Hydrogenation of Substance III triacetate with platinic oxide in ethyl acetate produced pale yellow crystals of tetrahydro-Substance III triacetate, m.p. 170-171°.

Attempted acetylation of tetrahydro-Substance III triacetate with acetic anhydride and sodium acetate at 140° returned the starting material, unchanged. This experiment indicates that no new hydroxyl group was formed during the hydrogenation of Substance III triacetate.

The ultraviolet absorption spectra of Substance III triacetate and tetrahydro-Substance III triacetate have been measured. A comparison of these data with the ultraviolet absorption data for Substance I derivatives (Looker[2]) indicates that Substance I and Substance III are closely related.

Infrared spectra for Substance I, tetrahydro-Substance I, Substance III triacetate, and tetrahydro-Substance III triacetate have been measured. These data are in harmony with the infrared data reported for known flavones.[5]

Microfilm $2.50; Xerox $4.60. 90 pages.

1. McWain, P. "Root Bark Pigments of the Osage Orange (Maclura pomifera Raf.)." Master's thesis, The Ohio State University, 1947.

2. Looker, J. H. "Root Bark Pigments of the Osage Orange (Maclura pomifera Raf.) and Their Structure." Doctoral dissertation, The Ohio State University, 1949.

3. Thompson, A. "Report on the Osage Orange Root Bark Pigments." A report to the Graduate School, The Ohio State University, 1950.

4. Wolfrom, M. L., Looker, J. H., Dickey, E. E., Mc Wain, P., and Thompson, A. "Root Bark Pigments of the Osage Orange (Maclura pomifera Raf.)," Abstracts of Papers, 119th Meeting, American Chemical Society, Boston, Mass., April 2-5, 1951, p. 16M.

5. Hergert, H. L., and Kurth, E. F. "The Infrared Spectra of Lignin and Related Compounds. I. Characteristic Carbonyl and Hydroxyl Frequencies of Some Flavanones, Flavones, Chalcones and Acetophenones," J. Am. Chem. Soc., 75 (1953), pp. 1622-1625.

Abstract published by special arrangement with The Ohio State University.

THE CATALYTIC ACTION OF ANION-EXCHANGE RESINS IN THE HYDROLYSIS OF NITRILES

(L. C. Card No. Mic 59-5986)

James B. Pierce, Ph.D.
Case Institute of Technology, 1958

A strongly basic quaternary ammonium type of ion exchange resin in the hydroxide form has been used to catalyze the conversion of nitriles to amides. Aromatic amides are more easily prepared by this technique than are the aliphatic amides. The effects of crosslinking in the resin, the nature of the solvent, and the character of the group to which the nitrile function is attached have been studied. The rate at which benzonitrile hydrolyzes has been found to vary with the quantity of catalyst employed.

The mole fraction of absorbing species has been introduced as a unit of concentration in spectral analysis, and new equations for calculating mole fraction and the first order rate constant have been developed. The two component system, benzonitrile-benzamide, has been analyzed by using only one wavelength of light.

Microfilm $2.50; Xerox $4.20. 76 pages.

A STUDY OF THE JAPP-KLINGEMANN DECARBOXYLATION REACTION

(L. C. Card No. Mic 59-5145)

Herbert Joseph Pine, Ph.D.
University of Delaware, 1959

Supervisor: William A. Mosher

The reaction of substituted benzenediazonium chlorides and substituted β-keto esters as well as other compounds which undergo the Japp-Klingemann decarboxylation reaction have been studied. Information has been obtained on optimum conditions, substituent effects, kinetics, and the mechanism of the reaction.

Conditions which are most favorable were found to be a pH of approximately 5, a nitrogen atmosphere, a temperature of 0°, and the use of urea to destroy excess nitrous acid formed in diazotization.

A trend was observed in which the percentage yield, based on carbon dioxide evolved, decreased with an increase in the electronegativity of substituents in the para position of the benzyl group of the substituted α-acetylhydrocinnamic ester. This order was benzyl, o-benzyl, 2,5-dimethylbenzyl, p-methoxybenzyl, p-chlorobenzyl, and p-nitrobenzyl. The respective rate constants also decreased in the same order.

Variation of substituents on the diazonium salt had a negligible effect on the percentage yield.

The Japp-Klingemann reaction was shown to be first order in formation of product.

The mechanism appears to involve the attack by the electron deficient nitrogen of the diazonium chloride on a resonance stabilized carbanion. The unsaponified ester was shown to act as a better nucleophillic intermediate than the acid. Microfilm $2.50; Xerox $5.40. 110 pages.

STUDIES IN AROMATIC CHEMISTRY. PART I. THE REACTION OF 2,4-DINITROFLUOROBENZENE WITH N-METHYLANILINE. PART II. ATTEMPTS TO SYNTHESIZE SOME CYCLOPOLY-p-BENZYLENES.

(L. C. Card No. Mic 59-5577)

John Justin Randall, Ph.D.
The University of North Carolina, 1959

Supervisor: Joseph F. Bunnett

Part I.

The reaction of N-methylaniline with 2,4-dinitrofluorobenzene is sensitive to base catalysis whereas reactions with the corresponding chlorine and bromine compounds are not. In ethanol, the catalyzed rate is linearly proportional to the potassium acetate concentration. In 60% dioxane: 40% water, the catalyzed rate shows less than linear response to hydroxide ion concentration at higher concentrations of the base. The acetate-catalyzed rate is not depressed by added acetic acid; the reaction is thus general base catalyzed.

These observations are inconsistent with any form of one-step mechanism for the displacement reaction. They are, however, rationally interpretable in terms of a two-step intermediate complex mechanism. In combination with other recent work from this laboratory, the present evidence firmly establishes the intermediate complex mechanism for a large group of aromatic nucleophilic substitution reactions, and makes this mechanism extremely probable for all such reactions.

Part II.

Because of the ability of divalent nickel salts to promote cyclo-tetramerization of unsaturated monomers, it was expected that the decomposition of the Grignard reagent of p-bromobenzylphenyl ether in the presence of nickel cyanide would yield cyclotetra-p-benzylene. Unfortunately, no suitable solvent for the reaction could be found.

An attempt to synthesize ketopenta-p-benzylene by pyrolyzing divalent metal salts of penta-p-benzylene-p,p'-dicarboxylic acid was made. The diacid, previously unknown, was synthesized from p-acetyldiphenyl methane

and terephthaloyl chloride through a Friedel-Crafts reaction, haloform oxidation of the resulting diacetyl compound, and Wolf-Kishner reduction of the remaining carbonyl groups. Pyrolysis of the diacid calcium, iron, and barium salts yielded only penta-p-benzylene, a decarboxylation product.

Attempts to prepare penta-p-benzylene-p,p'-dialdehyde were unsuccessful. It was hoped that the dialdehyde might be converted to a cyclic benzoin from which a series of ring contraction steps would give ketocyclopenta-p-benzylene. Reaction of the diacid chloride of penta-p-benzylene-p,p'-dicarboxylic acid with magnesium-magnesium iodide reagent yielded only polymeric benzoin condensation products.

About 15 new compounds were prepared in the course of this research.

Microfilm $2.50; Xerox $6.60. 138 pages.

METAL-ION-CATALYZED DECOMPOSITIONS OF BETA-SUBSTITUTED ORGANIC SULFIDES

(L. C. Card No. Mic 59-4657)

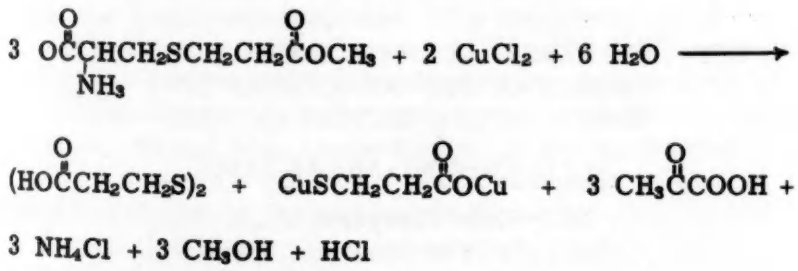
James Robert Schaeffer, Ph.D.
University of Pennsylvania, 1959

Supervisor: Donald C. Dittmer

Since cleavage of a carbon-sulfur bond of an organic sulfide may be involved in the hydration step of the fatty-acid cycle the present work was undertaken to obtain information concerning the stability of S-alkylcysteines which are structurally related to compounds present in cells. Since many enzymatic reactions are catalyzed by traces of metal ions, it was felt that complex formation between the metal ion and the sulfide group or chelation between the metal ion and the various functional groups of the sulfides may lead to carbon-sulfur bond cleavage.

Methyl β-(2-carboxy-2-aminoethylthio)-propionate was prepared by the addition of cysteine to methyl acrylate and treated with the chlorides of copper, nickel, zinc, manganese, magnesium, iron, cobalt, mercury, palladium, chromium III, and silver nitrate.

Pyruvic acid, β,β'-dithiodipropionic acid, and di-cuprous-β-mercaptopropionate were produced when methyl β-(2-carboxy-2-aminoethylthio)-propionate was heated with cupric chloride for 21 hours at 70° and pH 1.



$$3\ \mathrm{OCCHCH_2SCH_2CH_2COCH_3} + 2\ \mathrm{CuCl_2} + 6\ \mathrm{H_2O} \longrightarrow$$

$$(\mathrm{HOCCH_2CH_2S})_2 + \mathrm{CuSCH_2CH_2COCu} + 3\ \mathrm{CH_3CCOOH} +$$

$$3\ \mathrm{NH_4Cl} + 3\ \mathrm{CH_3OH} + \mathrm{HCl}$$

Pyruvic acid and the metal mercaptides were formed when methyl β-(2-carboxy-2-aminoethylthio)-propionate was heated with palladium chloride or mercuric chloride for 21 hours at 70° and pH 1.

The metal ions appear to be responsible for the decompositions since methyl β-(2-carboxy-2-aminoethylthio)-propionate did not undergo carbon-sulfur bond cleavage when treated with hydrochloric acid under the above conditions.

The decomposition appears to be general for S-alkylcysteine compounds since β-(2-carboxy-2-aminoethylthio)-propionic acid and S-methylcysteine were decomposed by cupric chloride.

The α-amino carboxylic acid structure appears necessary for carbon-sulfur bond cleavage because neither β,β'-thiodipropionic acid nor methyl-2-aminoethyl sulfide were decomposed by cupric chloride.

Several intermediates which could lead to the above products were proposed; of these formation of α-amino acrylic acid appears to be the most probable. The effect of cupric chloride on model compounds was studied in order to obtain further information concerning the mechanism of the reaction. A mechanism involving chelation of cupric ions with the amino acid has been proposed.

Microfilm $2.50; Xerox $6.20. 130 pages.

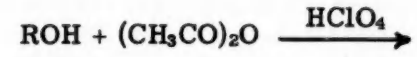
QUANTITATIVE ACID-CATALYZED ACETYLATION

(L. C. Card No. Mic 59-5677)

George Harry Schenk, Jr., Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dr. James S. Fritz

The usual functional group method of assaying alcohols is to heat the sample with a mixture of acetic anhydride and pyridine for 30 minutes to one hour. The use of 0.15M perchloric acid as catalyst results in an improved room temperature method using both neutral and basic organic solvents:



$$\mathrm{ROH} + (\mathrm{CH_3CO})_2\mathrm{O} \xrightarrow{\mathrm{HClO_4}} \mathrm{CH_3COOR} + \mathrm{CH_3COOH}$$

In neutral solvents such as ethyl acetate, trialkyl phosphates, chloroform or dimethoxyethane, a quantitative reaction takes place in less than five minutes for primary and secondary alcohols, phenols, and simple amines. Quantitative data for acetylation in ethyl acetate of 20 alcohols ranging from methanol to the hindered cis-2-t-butylcyclohexanol is presented.

In basic solvents such as pyridine, a quantitative reaction takes place in five minutes for primary alcohols, 10 minutes for tertiary hydroperoxides, 10 to 30 minutes for unhindered secondary alcohols, and 15 to 20 minutes for unhindered phenols.

Because tertiary alcohols partially dehydrate in neutral solvents but do not react in pyridine, primary or secondary alcohols can be determined in the presence of tertiary alcohols. Large amounts of cyclohexanol are also estimated in the presence of small amounts of cis-2-t-butylcyclohexanol. Simple phenols are estimated in the presence of equimolar amounts of o-t-butylphenol or 2,6-di-t-butyl-p-cresol.

Because triphenylcarbinol is quantitatively dehydrated by perchloric acid, diphenylcarbinol is estimated in the presence of triphenylcarbinol in ethyl acetate as long as the amount of perchloric acid exceeds the amount of triphenylcarbinol.

Acetylation in ethyl acetate is also satisfactory for determining sugars such as lactose. Acetylation in pyridine is used for assaying oximes such as cyclohexanone oxime and benzoin oxime.

Double bonds and aldehydes are serious interferences in neutral solvents, and aldehydes interfere also in basic solvents. Ketones interfere in neutral solvents but the interference of simple ketones can be eliminated by chilling reagent and sample to 0^{0}. The triple bond of propargyl alcohol does not interfere in either type of solvent. Activated aromatic compounds such as indene or m-dimethoxybenzene interfere seriously in neutral solvents.

The average precision of the method is 0.3%. The accuracies range from 98 to 100% in most cases. Checks for purity by other methods on a number of compounds gave differences never greater than 0.5%.

Of all the solvents tested, only ethyl acetate, chloroform, and trialkyl phosphates retain satisfactory colors and stability over a two week period. Dimethoxyethane develops peroxides which apparently cause serious discoloration. The pyridine reagent is stable for about 12 hours after which it develops a violet to black color and decreases in acid content. Dimethylformamide, dimethylaniline, 2-methylpyridine, and 2,6-dimethylpyridine retard acetylation compared to pyridine as solvent. Nitromethane, acetonitrile, and dimethylsulfoxide are unsatisfactory with regard to color or interferences.

Microfilm $2.50; Xerox $3.60. 63 pages.

INVESTIGATION OF POSSIBLE ROUTES FOR THE SYNTHESIS OF PYRIMIDO[4,5-e]1,2,4-TRIAZINES

(L. C. Card No. Mic 59-5587)

Harold Mellon Taylor, Ph.D.
The University of North Carolina, 1959

Supervisor: R. L. McKee

Several routes for the synthesis of pyrimido[4,5-e]-as-triazines have been investigated.

The reaction of alloxan with semicarbazide and its derivatives gave products with properties expected of the pyrimido-triazines. Mild hydrolysis of these adducts gave derivatives of mesoxalic acid. More severe hydrolysis resulted in the formation of as-triazines. Reductive cleavage of three of the derivatives gave uramil in good yield. This information, with spectral data obtained from a 4,4-dimethyl-3-thiosemicarbazone, indicate that the products obtained are simple semicarbazones.

Several attempts were made to produce a 3-hydroxy-as-triazine-5,6-dicarboxylic acid by interaction of dihydroxytartaric acid with semicarbazide. A disubstituted derivative was obtained, forming in preference to a monosubstituted product. Attempts to cyclize this product by splitting out one semicarbazide group did not yield the desired product. A substance was obtained which at present has not been identified, but, from analytical data, is clearly not the desired product. It had been hoped that the dicarboxylic acid could be converted to a diamide via a diester. Treatment of the amide with hypobromite would probably give a mixture of two isomeric pyrimido-as-triazines.

The reaction of 4,6-dichloro-5-nitropyrimidine with guanidine, under a variety of conditions, gave only impure products which could not be characterized. Attempts to prepare a guanido-nitropyrimidine by fusion of cyanamide, dimethylcyanamide and cyanamide dihydrochloride were futile. These "ortho" nitroguanidopyrimidines would be expected to react similarly with orthonitrophenylguanidine which cyclized to 3-aminobenzo-as-triazine-1-oxide on heating in strong base.

Chlorination of ethyl 3-mercapto-5-hydroxy-as-triazine-6-carboxylate with phosphorus oxychloride and dimethylaniline gave poor yields of the 3,5-dichloro compound. This material was not isolated but on treatment with ammonia 3,5-diamino-as-triazine-6-carboxamide was isolated. This material, on refluxing in diethoxymethyl acetate, was cyclized to 3-amino-8-hydroxypyrimido(4,5-e)-as-triazine.

Microfilm $2.50; Xerox $4.60. 89 pages.

STUDIES OF THE ACYLOIN CONDENSATION

(L. C. Card No. Mic 59-4185)

Hugo Ralph Usala, Ph.D.
Purdue University, 1959

Major Professor: James H. Brewster

The acyloin reduction of some para-substituted ethyl phenylacetates were investigated. Ethyl p-aminophenylacetate gave only resinous material. Reduction of ethyl p-chlorophenylacetate yielded the dechlorinated products dibenzyl ketone, diphenyl acetoin and diphenyl biacetyl. These products were also obtained from the reduction of ethyl phenylacetate. The acyloin reduction of ethyl p-methoxyphenylacetate gave good yields of bis(p-methoxyphenyl)acetoin and small amounts of a compound believed to be 1,4-di(p-methoxyphenyl)-but-3-en-1-one. Treatment of ethyl p-nitrophenylacetate with sodium in ether gave small amounts of meso- and d,l-diethyl 2,3-bis(p-nitrophenyl)succinate. These products were shown to be produced by small amounts of sodium ethoxide generated in the reaction. This suggests that the nitro groups were the oxidizing agents since oxygen was excluded from the reaction. Microfilm $2.50; Xerox $4.60. 89 pages.

THE SYNTHESES, ULTRAVIOLET ABSORPTION SPECTRA AND REACTIONS OF THE o- AND p-KETOSTYRENES.

(L. C. Card No. Mic 59-5656)

Billy Dale Vineyard, Ph.D.
University of Missouri, 1959

Supervisor: Dr. Wesley J. Dale

The method of Gensler and co-workers for the preparation of o-acylstyrenes from the hydrolysis of 1-alkyl-3,4-dihydroisoquinolines in the presence of dimethyl sulfate and sodium hydroxide has been shown to be a general

method for o-acylstyrenes with saturated acyl groups. By this method were prepared o-acetyl-, o-propionyl-, o-butyryl-, o-valeryl-, o-hexanoyl-, o-heptanoyl-, o-octanoyl-, o-decanoyl-, o-lauroyl-, o-myristoyl-, o-palmitoyl-, o-stearoyl- and o-benzoylstyrene in good yields (50 to 80%).

The procedure devised by Dale and Levine, which involves the preparation and pyrolysis of beta-(p-acylphenyl)-ethyl acetates, was shown to be a general method for p-acylstyrenes with saturated acyl groups. The following compounds were prepared in good yields (40 to 80%) by this method: p-acetyl-, p-propionyl-, p-butyryl-, p-isobutyryl-, p-valeryl-, p-hexanoyl-, p-octanoyl-, p-nonanoyl-, p-lauroyl-, p-myristoyl-, p-palmitoyl- and p-stearoylstyrene.

The ultraviolet absorption spectra of the o-ketostyrenes were all very similar except that of o-hexanoylstyrene. The absorption spectrum of p-stearoylstyrene was somewhat different from the spectra of the other p-ketostyrenes.

The chemical behavior of a variety of o- and p-ketostyrenes toward nucleophilic reagents such as sodio malonic ester, Grignard reagents and secondary amines was investigated.

The Michael additions of sodio malonic ester with p-acetyl- and p-hexanoylstyrene were accomplished in yields of 49 and 36%, respectively, after a reflux time of 20 hours. The reactions of sodio malonic ester with o-acetyl-, o-valeryl-, o-hexanoyl- and o-heptanoylstyrene gave Michael adducts in 37, 26, 17 and 17% yields, respectively, after a reflux time of 45 hours. Due to the greater steric requirements in the ortho isomers it was thus necessary to use longer reflux times to obtain yields of Michael adducts comparable to those obtained from the p-ketostyrenes.

The o-ketostyrenes reacted with unbranched Grignard reagents to give the normal (1,2) addition product. The following unbranched Grignard reagents were reacted with o-valeryl-, o-hexanoyl- and o-heptanoylstyrene: ethylmagnesium bromide, 2-phenylethylmagnesium bromide, benzylmagnesium chloride and n-propylmagnesium bromide. The yields of alcohols obtained from the above series of Grignard reactions were always less for o-hexanoylstyrene than for the other ketostyrenes with the same Grignard reagent. An explanation of this behavior is that the carbonyl group is relatively more hindered in o-hexanoylstyrene than in o-valeryl- and o-heptanoylstyrene, possibly because the six carbon atoms of the side chain are twisted around in a ring configuration. This fact is consistent with the anomalous absorption spectrum of o-hexanoylstyrene.

The following ketostyrenes were allowed to react with t-butylmagnesium chloride: o-acetyl-, o-valeryl-, o-benzoyl- and p-isobutyrylstyrene. The adducts obtained were those resulting from conjugate addition (1,6 addition to the ortho isomers and 1,8 addition to the para isomer) of the Grignard reagent to the unsaturated systems in yields of 34, 21, 65 and 45%, respectively. It was shown that in order to obtain 1,8 addition a hindered ketone as well as a branched Grignard reagent had to be used.

It was also shown that the acetyl group of o- and p-acetylstyrene will undergo essentially the same reactions as the acetyl group in acetophenone. 4-Vinylbenzalacetophenone was obtained in an 80% yield by a Claisen-Schmidt type reaction between p-acetylstyrene and benzaldehyde. The haloform reaction of o- and p-acetylstyrene gave the corresponding vinylbenzoic acids in yields of 63 and 66%, respectively. The glycidic esters were obtained from the reaction of o-acetyl- and o-valerylstyrene with ethyl chloroacetate in an alkaline solution.

Pyrrolidine was observed to add readily to the vinyl group of o-acetyl- and o-valerylstyrene to form adducts in yields of 34 and 31%, respectively.

Microfilm $2.50; Xerox $6.60. 137 pages.

DEGRADATIVE AND SYNTHETIC STUDIES ON PIGMENTS OF THE OSAGE ORANGE

(L. C. Card No. Mic 59-6659)

Oscar Michael Windrath, Jr., Ph.D.
The Ohio State University, 1954

As a result of an investigation directed by Professor M. L. Wolfrom and conducted in the laboratories of the Department of Chemistry at The Ohio State University, two crystalline pigments, osajin and pomiferin, have been isolated from the fruit of the osage orange and their chemical constitution determined.[1] An isoflavone nucleus is present.

In 1941, Wolfrom and Dickey[2] isolated a crystalline pigment from the root bark of the osage orange. Further improvement in the isolation were devised by McWain.[3] Through chromatography he isolated a second yellow pigment which he called Substance II; the pigment isolated earlier was designated Substance I. Investigation by McWain[3] and Looker[4] did much to develop the structures of these two root bark pigments. Thompson[5] developed an improved method for the isolation of Substance I and isolated a third pigment from the root bark labeled Substance III. Structural studies on this compound were inconclusive.

The object of the present investigation was twofold. Confirmation of the structures of the fruit pigments osajin and pomiferin through synthesis was to be attempted. Previously, Wolfrom and Wildi[6] had succeeded in preparing the derivatives dihydro-iso-osajin and dihydro-iso-pomiferin. A continuation of degradative studies initiated by McWain[3] and Looker[4] was to be undertaken. It was desirable to develop methods of degradation by which sufficient amounts of material could be obtained without the necessity of sacrificing unnecessarily large amounts of the pigments. An identification of these degradation products was to be attempted in the hope that this would culminate in the determination of the basic structures of the root bark pigments.

No useful synthesis of an isoflavone has appeared which does not require a deoxybenzoin intermediate. Such compounds can be prepared by a number of different methods, of which the most applicable are the Houben-Hoesch reaction, the Friedel-Crafts reaction, and the Fries rearrangement. Application of these methods to the syntheses of osajin and pomiferin is complicated by the 2,2-dimethylpyran grouping, present as a chromeno-chromone unit, appended to the isoflavone nucleus. This structure is shown in Figure 1.

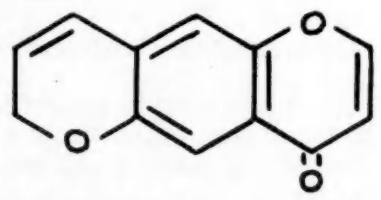


Figure 1. A Chromeno-chromone unit (one isomer shown)

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The usual proof of structure by synthesis for natural products which contain this grouping involves preparing the dihydro-derivative and comparing it with the compound obtained by catalytic reduction of the natural substance. A synthetic approach to the problem of including this structure in the preparation of osajin and pomiferin involved the intermediate 5,7-dihydroxy-2,2-dimethyl-Δ^3-chromene as shown in Figure 2.

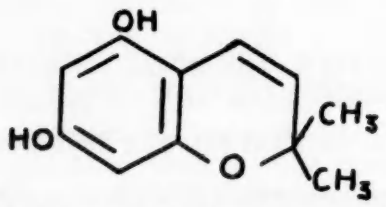


Figure 2. 5,7-dihydroxy-2,2-dimethyl-Δ^3-chromene

Three methods were applied without success in an attempt to prepare a compound of this structure.

1. The action of methylmagnesium iodide on 5,7-dihydroxycoumarin and etherified and acetylated derivatives
2. A Meerwein-Ponndorf reduction on 5,7-dihydroxy-2,2-dimethylchromanone and etherified derivatives
3. Deetherification of 5-benzyloxy-7-methoxy-2,2-dimethylchromene

The ultimate product was invariably a yellow oil which quickly resinified and resisted all methods of inducing crystallization. Apparently the presence of nucleophilic substituents in the 5 and 7 positions renders the product unstable. Whalley[7] has postulated the formation of an unstable benzopyrylium salt which readily undergoes decomposition.

Another approach to this problem was an attempt to prepare the appropriate isoflavone nucleus and then insert the dimethylpyran side chain. It was believed this could be accomplished through the reaction of an 8-lithium isoflavone with senicaldehyde followed by rearrangement of the allyl side chain to a propenyl group with subsequent cyclization. The reaction of this product with isopentenyl bromide and sodium would introduce the required side chain.

To initiate these series of reactions necessitated the preparation of an 8-lithium isoflavone. It was believed this could be best achieved through replacement of a halogen in the 8 position by reaction with phenyl lithium. An examination of the pertinent literature failed to reveal the preparation of an isoflavone containing a halogen in a known position. An exploratory investigation to determine whether a halogen on a deoxybenzoin could endure a sodium-(ethyl formate) cyclization (a standard method for the preparation of isoflavones) produced the desired halogeno-isoflavone 6-methyl-8-chloro-isoflavone shown in Figure 3.

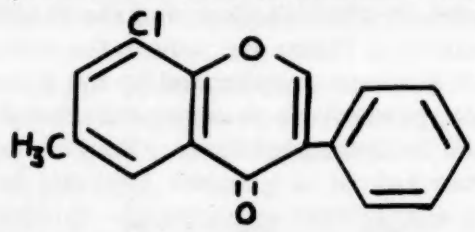


Figure 3. 6-methyl-8-chloroisoflavone

Since it did not seem possible to prepare an appropriately substituted benzene ring which would contain an hydroxyl group adjacent to the halogen and methoxy groups ortho-para to it, the Fries rearrangement could not be included as a method to be used in preparing the deoxybenzoin needed as an intermediate in the synthesis of osajin by the method outlined above. Both the Houben-Hoesch and the Friedel-Crafts reactions were run with halogenated, methoxylated aromatics and the products were always deficient in halogen. This indicated a preferential attack of the acyl group on the position occupied by the halogen. As a consequence of the unsatisfactory results of these exploratory investigations, this method of approach was also abandoned.

The major effort in degradative studies on the root bark pigments naturally involved Substance I since it was available in greatest quantity. A difficulty was its apparent extraordinary resistance to attack by dilute alkali, a fact which prompted the suggestion that Substance I contained a flavone or flavonol nucleus. However, as evidenced by numerous examples in the literature, compounds containing these structures are not unusually resistant to clean degradation by alkali. Methoxyl groups are usually resistant to fission under the conditions employed. Yet, when tetrahydro-Substance I trimethyl ether was reacted with potassium hydroxide-dioxane mixture, demethylation occurred preferentially to a nuclear fission. From a consideration of the ultraviolet absorption spectra the probability is that a flavone or flavonol nucleus is not favored. This tends to substantiate the poor results from degradative action of alkali. However, there is a favorable comparison between the ultraviolet spectra of xanthone and its derivatives and Substance I as shown in Table I.

Table I

Ultraviolet Spectra of Derivatives of Xanthone[8] and Substance I

Compound	Wave length		
Xanthone Derivatives	2500 Å.	2800 Å.	3300 Å.
Substance I	2280	2825	3375

A test indicative of a xanthydrol was obtained when the product from the reaction of Substance I with a Grignard reagent was dissolved in sulfuric acid. This also would suggest a xanthone nucleus for Substance I. Acetone was identified by X-ray diffraction data and infrared spectroscopy on the 2,4-dinitrophenylhydrazone as a degradation product from the attack of 30 per cent potassium hydroxide on Substance I. Its formation is good proof for the presence of a 2,2-dimethylchromene structure.

Looker[4] has established the molecular formula for Substance I as $C_{23}H_{22}O_6$. It contains 3 hydroxyl groups, 2 probably adjacent on an aromatic nucleus and 1 "peri" to a carbonyl group of a γ-pyrone structure.

There is strong indication, therefore, that Substance I is a compound which possesses a xanthone nucleus to which are attached three hydroxyl groups and a 2,2-dimethylchromene structure. This would amount to a molecular formula of $C_{18}H_{14}O_6$. The difference between this formula and that of Substance I, $C_{23}H_{22}O_6$ is C_5H_8. This is an isoprene unit, a grouping of carbon and hydrogen that is found in numerous natural products.

From the heartwood of Calophyllum brasiliensis, King and co-workers[9] have isolated and identified a natural product, jacareubin, which contains the structural features

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referred to above. An examination of the ultraviolet spectra of jacareubin reveals a favorable comparison with that of Substance I. This is illustrated in Table II.

Table II

Ultraviolet Spectra of Substance I and Jacareubin

Compound	λ	$E_{Max.}$	λ	$E_{Max.}$	λ	$E_{Max.}$
Substance I	2280	26,600	2825	45,000	3375	19,500
Jacareubin	2400	12,200	2790	40,200	3340	18,200

Each of the last two maxima differ by 35 Å.; this is significant because it has been established[10] that a shift to the right approximating 50 Å. units occurs in the ultraviolet spectrum if an allylic side chain is attached to a polynuclear compound. This would tend to substantiate the suggestion that in Substance I an isoprene unit is appended to a xanthone nucleus whose structure is similar to that of jacareubin.

Neutral permanganate oxidation of Substance I trimethyl ether in acetone has produced a dibasic acid which appears to be a dihydrate of the molecular formula $C_{22}H_{22}O_{10} + 2H_2O$. A compound of this formula could feasibly be produced by oxidation of the isoprene side chain and the points of unsaturation on the dimethyl pyran ring.

Because Substance II is scarce (in this work it has been separated by fractional crystallization from crude Substance I), it has not been further investigated. Looker[4] has fairly well established the formula as $C_{18}H_{14}O_5$. Two acetylatable hydroxyl groups are present as is also a γ-pyrone structure. The ultraviolet absorption spectra of Substance II compares quite favorably with that shown by some hydroxylated flavonols. A simple method of proof for the postulation that Substance II is a hydroxylated flavonol would be a study of the ultraviolet absorption pattern for the completely methylated derivative. Methylation of flavonols convert their spectra into that of the corresponding flavone; that is, the three band spectra reverts to a two band spectra.

The pigment Substance III, first isolated by Thompson,[5] is quite unstable and becomes highly colored on standing. Vigorous and mild acetylation gave the same product and a hydrogen uptake of two moles indicated two easily reduced double bonds. The inability to induce further acetylation in the presence of a reducing agent indicates the absence of a structure related to napthoquinone, anthroquinone, or a carbonyl side chain. A γ-pyrone structure is present as is also a 2,2-dimethylpyran ring, evidenced by the isolation of acetone from alkaline degradation. A positive periodate test for the catechol grouping in Substance III indicated the hydroxyl groups are adjacent.

The addition of new analytical data has made possible a more thorough study and a new molecular formula has been derived whose composition corresponds closely with the observed values. The data are presented in Table III.

Now, on the basis of the facts presented above we must include the following points in any formula which is proposed for Substance III.

1. The nucleus contains a γ-pyrone ring.
2. Two adjacent phenolic hydroxyl groups are present but none is "peri" to the carbonyl in the γ-pyrone structure. There is no methoxy group in the compound.

Table III

Compound	Calculated values	Observed values*
Substance III ($C_{19}H_{20}O_5$)	C, 69.51; H, 6.10; mol. wt., 328	C, 69.31; H, 6.12; mol. wt., (Rast) 384
Substance III dimethyl ether ($C_{21}H_{24}O_5$)	C, 70.78; H, 6.74; 2 OCH_3, 17.43; mol. wt., 356	C, 70.96; H, 6.78; OCH_3, 17.55; mol. wt., 410
Substance III diacetate ($C_{23}H_{24}O_7$)	C, 66.99; H, 5.83; 2 C-CH_3, 13.12; mol. wt., 412.	C, 66.80; H, 5.97; C-CH_3, 13.3; mol. wt., (Rast),496; OCH_3, less than 0.3
Tetrahydro-Substance III diacetate ($C_{23}H_{28}O_7$)	C, 66.34; H, 6.72.	C, 66.44; H, 6.68.

*All analysis by Huffman Microanalytical Laboratory except analysis of Substance III by Mrs. Klotz and that of tetrahydro-Substance III diacetate by Mr. Warfel.

3. Two easily reduced double bonds are present.
4. A 2,2-dimethylchromene structure is present.
5. The formula is $C_{19}H_{20}O_5$.

A possible formula to which the above facts apply is shown in Figure 4. The presence of a group as C=CH-CH_2- is indicated by infrared absorption bands at 10 and 11.2 microns. A $(CH_3)_2C=$ group is suggested by bands at 8.57 and 8.78 microns.

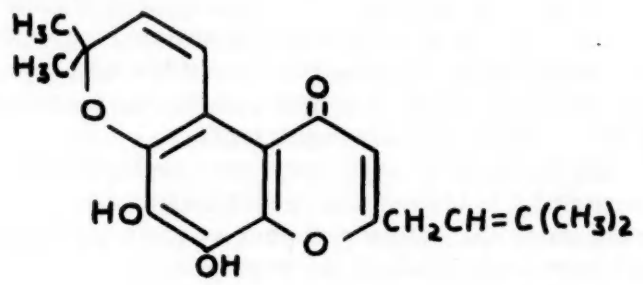


Figure 4. Proposed formula for Substance III

Microfilm $2.50; Xerox $6.00. 122 pages.

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Abstract published by special arrangement with The Ohio State University.

CHEMISTRY, PHARMACEUTICAL

THE METABOLISM AND CENTRAL NERVOUS SYSTEM DISTRIBUTION OF C-14 CARBONYL SALICYLAMIDE IN THE RAT

(L. C. Card No. Mic 59-6471)

William Frederick Bousquet, Ph.D.
Purdue University, 1959

Major Professor: John E. Christian

This investigation was undertaken to determine the uptake of C-14 carbonyl salicylamide in various areas of the rat central nervous system. The metabolites of this compound present in the urine of normal animals were identified and compared with those present in the urine of hypophysectomized animals. Various tissues were examined for the presence of metabolic products.

Carboxyl labeled salicylic acid was synthesized by the halogen-metal interconversion reaction followed by carbonation with $C^{14}O_2$. C-14 carbonyl salicylamide was synthesized by ammonolysis of the methyl ester of C-14 carboxyl salicylic acid.

In studying the central nervous system distribution pattern of the labeled compound, animals were sacrificed at 5, 15, 30, 60 and 120 minutes after intraperitoneal injection of 100 mg/Kg. of salicylamide containing 3.0 μc of C-14 activity. The brains were perfused with saline and the medulla, cerebellum, cerebral cortex, hypothalamic area, cerebrospinal fluid and pituitary, along with the adrenals and the plasma analyzed for their radioactivity content. The pituitary gland showed the greatest uptake of radioactivity. Most areas studied showed peak uptake at the 15 minute time interval. The plasma peak occurred at 30 minutes and appears to coincide with removal of the drug from the tissues. The cerebrospinal fluid-plasma ratio reached unity in 12 minutes indicating rapid transport from the plasma.

A 24 hour urine sample from animals receiving 100 mg./Kg. of salicylamide containing 3.0 μc of C-14 activity was acid hydrolyzed, extracted with ether and subjected to paper partition chromatographic separation. Metabolites present were identified as salicylamide and gentisic acid amide. Identical products were present in the urine of hypophysectomized animals. Gentisic acid amide was shown to be present in the urine to the extent of between 5 and 30 per cent.

Examination by paper chromatographic methods of ether extracts of brain, pituitary, cerebrospinal fluid, adrenals and plasma of rats dosed as above revealed the presence of free salicylamide in these tissues. No other metabolites were present in the tissue extracts.

The finding of identical metabolites in the normal and hypophysectomized animals indicates that the pituitary does not play a role in the hydroxylation of salicylamide.

Microfilm $2.50; Xerox $5.40. 107 pages.

CHEMISTRY, PHYSICAL

REFLECTION SPECTRA OF MOLECULAR CRYSTALS

(L. C. Card No. Mic 59-5480)

Basil Gideon Anex, Ph.D.
University of Washington, 1959

Chairman: William T. Simpson

A spectrophotometer that allows one to obtain the polarized reflection spectra of single crystals in the visible and ultraviolet regions of the spectrum has been designed and constructed.

In order to demonstrate the value of reflection spectroscopy as a method of investigating the absorptive properties of highly absorbing crystals, the reflection spectra of three faces of the auramine perchlorate (auramine) crystal have been obtained and related to the previously obtained single molecule absorption and polarization data. It has thus been shown that if the crystal structure of auramine were available, one could make absolute experimental assignments of the molecular transitions of this compound on the basis of the observed reflection spectra.

The reflection spectra of 1,5-bis-(dimethylamino)-pentamethinium perchlorate (BDP) and two related dyes have also been studied. These substances show very strong reflection over an extended spectral range, while the related single molecule absorption is quite narrow. This striking effect has been termed "metallic reflection" and has been investigated from a theoretical point of view. Through the application of classical dispersion theory it has been possible to understand metallic reflection in terms of fundamental molecular and crystal properties and to develop criteria for its appearance. The results for one face of BDP provide a prime example of metallic reflection and have been subjected to extensive theoretical analysis.

The unusual appearance of one of the reflection spectra for auramine has been interpreted as resulting from the incipient appearance of metallic reflection. Thus auramine may be taken as a borderline case for the occurrence of this effect and, as such, provides a critical test of theoretical interpretations of it.

The analysis of the results for BDP has provided further experimental verification of the existence of the internal field. Moreover, a general method for including "the internal field correction" in treatments of crystalline phenomena has been proposed and applied.

It has been shown that one may draw important

conclusions regarding the nature of the crystal absorption involved when metallic reflection occurs. Evidence that metallic reflection indicates an extended range of crystal absorption has been presented. It has also been demonstrated that metallic reflection is a strong coupling phenomenon and, in this regard, a new method of applying the coupling inequality of Simpson and Peterson has been proposed.

The height of the metallic reflection curve has been interpreted as giving an indication of the lifetime of the associated crystal absorption. It has thus been possible to draw inferences regarding the dissipative forces at work within the crystal.

Microfilm $2.50; Xerox $7.80. 167 pages.

THE DIELECTRIC PROPERTIES OF THE ALUMINUM OXIDE - WATER SYSTEM

(L. C. Card No. Mic 59-5540)

Mart Gelzer Baldwin, Jr., Ph.D.
The University of North Carolina, 1959

Supervisor: J. C. Morrow

In this dissertation, data dealing with the dielectric constant and loss factor of the aluminum oxide - water system as functions of the amount of water adsorbed, of the frequency, and of the temperature are presented, as well as the adsorption isotherm for water vapor on alumina. The findings are discussed in terms of possible polarization mechanisms, and the following conclusions are drawn:

1) The polarization of molecules in the monolayer is very small, involving neither dipole orientation nor ionic conduction.

2) Following completion of the monolayer, the sharply increased dielectric constant and the maximum in the dielectric loss factor arise from the orientation of the molecular dipoles in the direction of the field. This orientation involves primarily activated jumps by the molecules from one equilibrium position to another.

3) The extremely high dielectric constant and loss appearing at sufficiently large values of the amount adsorbed result from ionic conduction in the adsorbed layer.

Microfilm $2.50; Xerox $4.80. 93 pages.

THE MERCURY PHOTOSENSITIZED DECOMPOSITION OF WATER VAPOR

(L. C. Card No. Mic 59-5348)

Harold Basseches, Ph.D.
The Ohio State University, 1951

The dissertation is concerned with a re-examination of the mercury photosensitized decomposition of water vapor by the use of a flow method.

The reaction involves the irradiation of a mixture of mercury vapor and water vapor by the resonance line λ2537Å from a low pressure mercury-neon gas discharge. The resonance radiation excites the mercury atoms from the ground state to the excited state ($^3P_1$). By inelastic collisions of the second kind, the excitation energy of the $^3P_1$ mercury atom is transferred to the water molecule. This excitation energy (112.651 kcal./g. atom) is not quite sufficient to bring about the dissociation of the water according to the reaction

$$H_2O = H + OH$$

A small amount of thermal energy is needed to supply the deficiency. This energy is usually supplied by the thermal motion of the particles.

The only other investigation of the reaction which used the flow method was that of Bates and Taylor[1] in 1927. They gave very little quantitative detail in regard to the experimental conditions. They apparently did not investigate the effect of temperature, pressure, or flow rate. Their analysis of the gaseous reaction products showed 73 per cent hydrogen and 27 per cent oxygen. They could not detect hydrogen peroxide in the products frozen out in a trap at liquid air temperatures.

Several investigations of the reaction between excited mercury vapor and water vapor have been carried out with the use of the static method. The earliest of these was performed by Senftleben and Rehren[2] in 1926. They found hydrogen to be the only gaseous product. They concluded that the water was dissociated into hydrogen atoms and hydroxyl radicals, and that this process required an energy less than the energy of the excited mercury atom (4.9 e.v.). Gaviola and Wood[3] reported in 1928 that the energy required for dissociation was greater than 4.9 e.v., and estimated a value of 5.1 e.v. from studies on the mercury-sensitized fluorescence of water vapor. Their studies provided evidence for the primary dissociation of the water into hydrogen atoms and hydroxyl radicals. Riechemeier, Senftleben, and Pastorff,[4] in the most complete investigation of the reaction by the static method, deduced a value of 5.11 ± 0.04 e.v. for the dissociation energy of water. They varied the water vapor pressure from 0.77 mm. to 10.5 mm. of Hg. and the temperature from room temperature to 230°C. They reported hydrogen to be the only gaseous product. In the only other investigation which used the static method, Melville[5] found quantum yields for water decomposition by excited mercury for one water vapor pressure over a temperature range of 45°C. to 580°C. Hydrogen was the only product found.

The earlier investigations made two important facts evident. Oxygen is absent as a gaseous product in all static investigations, but it has been reported as a product in a flow investigation. No detailed reaction mechanism has been proposed in any of the previous studies.

The process of the mercury photosensitized decomposition of water vapor is a kinetic phenomenon, and the interpretation of the results in regard to the dissociation energies depends on the mechanism assumed for the reaction. Since the mechanisms of earlier studies lack a sufficient basis, it is important to investigate the mechanism more thoroughly.

For the present research an extensive flow system was designed and built which permitted the study of the reaction over a range of pressures and temperatures. The flow system was adopted since only one other flow investigation existed, and it seemed advisable to verify the observations in regard to the reaction products. In addition, an important advantage of a flow system is that it enables products which might otherwise be decomposed to be

removed from the reaction zone. The analytical techniques were designed to make qualitative and quantitative measurements for hydrogen, oxygen, hydrogen peroxide, and mercuric oxide. The gaseous oxygen was separated from the gaseous hydrogen by freezing it out of the gas stream as the flow passed through a trap immersed in liquid hydrogen. Samples of the product gases were analyzed by use of a mass spectrometer. By this method a sensitive qualitative and quantitative analysis of the gaseous products was obtained.

The reaction was studied over a temperature range of about 100°C. to 500°C. at three different water vapor pressures: 4.3 mm., 18 mm. and 30 mm. of Hg. All these studies were carried out at a linear flow rate of 396 cm./sec. At a water vapor pressure of 30 mm. of Hg, a series of tests over the temperature range was also made at a linear flow rate of 60 cm./sec.

Hydrogen and oxygen were found as gaseous products under all conditions. Mercuric oxide was found as a product in a liquid air trap under all conditions. Hydrogen peroxide could not be detected in the condensable products in a trap maintained at liquid air temperatures in any of the experiments. Schales'[6] method, which was considered to be sensitive to one part in ten million, was used for peroxide detection.

The yield of hydrogen was found to increase linearly with temperature as the latter was varied from 100°C. to 500°C. in every pressure series.

Quantum yields for water decomposition was determined for tests at all pressures and temperatures. They are comparable in magnitude to those obtained by Melville,[5] but since the water vapor pressure used by this author was 8.5 mm., the values cannot be compared directly with the results of the present research.

The activation energy for the over-all reaction was found to remain constant with pressure, over the range studied. This finding does not substantiate a recent proposal by Edse[7] that the activation energy should increase as the pressure of water vapor increases.

From the results of the studies at different flow rates, it is concluded that oxygen was not found in static investigations probably because it was consumed to form mercuric oxide. This substantiates a similar proposal by Bates and Taylor.[1]

The dissociation energy of water to form hydrogen atoms and hydroxyl radicals was found to be 112.6 ± 0.1 kcal./mole at 0°K. The present method is shown to set an upper limit of 112.7 kcal./mole for this dissociation energy. The dissociation energy of the hydroxyl radical to form oxygen and hydrogen atoms was determined to be 105.7 ± 0.2 kcal./mole at 0°K. The method sets a lower limit of 105.5 kcal./mole for this dissociation energy.

A kinetic mechanism is proposed in terms of the rate of formation of hydrogen which is consistent with the data obtained in this research. This mechanism indicates that the rate of hydrogen formation is proportional to the water vapor concentration. Microfilm $2.65; Xerox $9.20. 204 pages.

1. Bates, J. R., and Taylor, H. S. "Studies in Photosensitization. I," J. Am. Chem. Soc., 49 (1927), pp. 2438–56.

2. Senftleben, H., and Rehren, I. "Ueber die Dissoziation des Wasserdampfmoleküls," Z. Physik., 37 (1926), pp. 528–38.

3. Gaviola, E., and Wood, R. W. "Photosensitized band fluorescence of OH, HgH, NH, H_2O, and HN_3 molecules," Phil. Mag., Seventh ser., 6 (1928), pp. 1191–1209.

4. Riechemeier, O., Senftleben, H., and Pastorff, H. "Ueber die Energieverhältnisse des Wasserdampfmoleküls in seine Atome," Ann. Physik., 19 (1934), pp. 202–17.

5. Melville, H. W. "A Note on the Quantum Yield of the Photosensitized Decomposition of Water and of Ammonia," Proc. Roy. Soc., A157 (1936), pp. 621–24.

6. Schales, O. "Empfindliche Methoden zum Nachweis von Wasserstoffperoxyd und seine Entstehung bei einigen Dehydrierungs-Vorgängen," Ber., 71B (1938), pp. 447–60.

7. Edse, R. Third Symposium on Combustion and Flame and Explosion Phenomena. Baltimore: Williams & Wilkins Company, 1949, pp. 611–17.

Abstract published by special arrangement with The Ohio State University.

A SPECTROPHOTOMETRIC STUDY OF THE ANALYTICAL CHEMISTRY OF VANADIUM

(L. C. Card No. Mic 59-6168)

Kenton E. Bentley, Ph.D.
The University of New Mexico, 1958

Because spectrophotometric analysis is capable of the accuracy requisite for research and the celerity desired for routine work, spectral methods were considered for a study of the analytical chemistry of vanadium.

Extraction procedures for use in developing a selective spectrophotometric method were investigated. Di-n-octylmethylamine was found to enter into a saltlike molecular formation with vanadium(V) which could be extracted from 6N hydrochloric acid solution with benzene.

A critical study was made of several methods for preparing vanadium(II), (III), and (IV) in 0.5 and 5M sulfuric acid, 0.5 and 5M hydrochloric acid, and 0.5M perchloric acid solutions. Techniques for preparing a single valence state of vanadium in an acid medium of a single anion were verified by volumetric analyses.

Fundamental absorption spectra were determined over the visible wave length region for vanadium(II), (III), and (IV) in the various media. No hypochromic or hyperchromic effects were evident in the several acid media. The absorption spectra of all vanadium(II) solutions were qualitatively alike. The spectral curves for vanadium(IV) in the different media varied slightly in the red region of the spectrum. Absorption spectra of vanadium(III) in 0.5M sulfuric acid, 5M hydrochloric acid, and 5M sulfuric acid solutions exhibited an increasing bathochromic effect, in that order.

The spectral data for the vanadium(II)-vanadium(III) and vanadium(III)-vanadium(IV) systems were employed in developing the theory of the isochrommetric-point method of spectrophotometry. Solutions of both systems were isochrommetric-point colorimetrically analyzed for total vanadium concentration and relative concentrations of the vanadium ions present. Vanadium was also determined in solutions of the various media by isochrommetric-point photometric titrations.

Microfilm $2.60; Xerox $9.00. 200 pages.

THERMODYNAMIC INVESTIGATION OF THE SOLUBILITY OF SILVER SALTS OF FATTY ACIDS

(L. C. Card No. Mic 59-5135)

Peter Demetrius Branton, Ph.D.
University of Delaware, 1959

Supervisor: Professor Cecil C. Lynch

The solubility of eight silver salts of saturated fatty acids, ranging from the heptanoate to the tetradecanoate, has been studied. The thermodynamic solubility product constants Ksp were determined by measurements of electromotive force of transference cells of the type

$$(-)\ Ag \mid AgR(sat), KClO_4 \parallel AgCl(sat), KCl \mid Ag\ (+)$$

at evenly spaced temperatures from 10° to 60°C. From experimental data, values of the thermodynamic functions ΔH°, ΔS°, and ΔC_p° for the equilibrium

$$AgR\ (crystal) \rightleftharpoons Ag^+\ (diss) + R^-\ (diss)$$

have been calculated, as well as the values of the standard potential E° of the electrodes of the second type AgR,R^-.

The values of log K_{sp} and of ΔS° exhibit a periodic variation with increasing number of carbon atoms in the hydrocarbon chain of the fatty acids, forming two continuous series of values, one each for the even- and odd-numbered terms. No such periodicity is apparent for either ΔH° or ΔC_p°.

This peculiar thermodynamic behavior can be accounted for by postulating a definite mechanism of the solute and by proposing a suitable model for the structure of the silver soap crystals and of the fatty acid anions. Both mechanism and structures are consistent with the statistical-mechanical, configurational and structural hypotheses advanced by the authorities in the field of ionic processes in solution.

The values of the contribution of the various steps of the postulated mechanism to the overall thermodynamics of the dissolution of silver soaps have been calculated, using both experimental data and statistical procedures. The essential correctness of the hypotheses made in the course of this work is attested by the fact, that values of the enthalpy of sublimation of silver soaps obtained in this fashion agree satisfactorily with values calculated independently from consideration of ionic and Van der Waals' forces in the crystals and their contributions to the lattice energy.

The introduction of fatty acid anions into a normally associated solvent, such as water, alters significantly the quasi-crystalline structure of the latter in the immediate vicinity of the anion. The overall result appears to be one of decreasing the frequency of breaking of hydrogen bonds and of increasing the degree of orientation of the water molecules involved. This stabilizing effect confirms the "order-inducing" or "entropy-decreasing" character of fatty acid anions and of many non-polar solutes, observed by such authors as Frank, Everett, and others. On the other hand, mixing and configurational effects, due to the internal rotation of atomic groups around carbon-carbon bonds in the anion, contribute to an increase of entropy. As a result of these two balancing influences, the net change of entropy of solution, though positive, is rather small. It is thus permissible to speak of an "ice-like" structure of water in the immediate vicinity of the ionic charge, and of a "solvent cage effect" around the non-polar portion of the anion.

Absolute entropies of both silver salt crystals and dissolved fatty acid anions have also been evaluated. The former exhibit the periodic character referred to before, the entropies of the even- and odd-membered terms differing by a constant amount; the anionic entropies, on the other hand, vary continuously with increasing number of carbon atoms. It thus appears justifiable to assign the cause of the observed periodicity to some specific differences in the crystalling structure of the silver salts of even- and odd-numbered acids, respectively.

It is probably that these differences may be due, primarily, to the relative orientation of parallel organic chains in neighboring unit cells, and to a varying longer-range degree of ordering of the successive ionic-hydrocarbon layers in the crystals of both series.

Microfilm $2.50; Xerox $6.20. 127 pages.

LIGHT SCATTERING STUDIES OF SELECTED POLYAMIDES

(L. C. Card No. Mic 59-5136)

Douglas W. Carlson, Ph.D.
University of Delaware, 1959

Supervisor: Professor Harold C. Beachell

Light scattering and viscosity investigations have been carried out in the solvent system 2,2,3,3,-tetrafluoropropanol + 0.1N sodium trifluoroacetate, on a series of polyamides (nylons) formed by the condensation of an aliphatic acid with an aliphatic diamine, by the condensation of an aliphatic amino-acid, or by the condensation of an aromatic diamine with an aliphatic acid. The aliphatic series consists of polyhexamethylene adipamide (66 nylon), polyhexamethylene sebacamide (610 nylon), polycaprolactam (6 nylon), and "Zytel" 61. ("Zytel" 61 is the trademark for a soluble nylon manufactured by E. I. du Pont de Nemours & Company, Inc.) The polymer containing an aromatic member is poly-m-xylylene adipamide (MXD-6).

The refractive index change with concentration (dn/dc) for the aliphatic nylons is 0.190 cc/g; the light scattering constant (H) is taken as 9.59×10^{-6} cm^2/g^2. For the aromatic polymer (MXD-6), the refractive index change is 0.236 cc/g and the light scattering constant is taken as 14.80×10^{-6} cm^2/g^2; all values determined with 4358Å incident radiation.

Molecular weights, second virial coefficients, and molecular dimension are reported for the various polymers investigated. Microfilm $2.50; Xerox $3.60. 64 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

NEW ADDITION REACTIONS OF NITRO COMPOUNDS WITH OLEFINIC SYSTEMS

(L. C. Card No. Mic 59-5355)

Franklin Junior Conrad, Ph.D.
The Ohio State University, 1952

Section I. - Additions of Dinitrogen Tetroxide and Nitryl Chloride to Olefinic Systems.

The purpose of the research was to determine the orientation in additions of dinitrogen tetroxide and nitryl chloride to acrylic systems and to arrive at possible conclusions concerning the mechanism of addition reactions of this type of olefinic systems.

Addition of dinitrogen tetroxide to methyl acrylate at 0° in ether yields, after hydrolysis, methyl 3-nitroacrylate (13 percent), methyl 2-hydroxy-3-nitropropionate (27 percent), oxalic acid, and polymers. No evidence for isomeric compounds was found.

$$CH_2{=}CH{-}CO_2CH_3 + N_2O_4 \xrightarrow[\text{Hydrolysis}]{0^\circ}$$

$$\underset{NO_2}{CH{=}CH{-}CO_2CH_3} + \underset{NO_2\ OH}{CH_2{-}CH{-}CO_2CH_3}$$

Methyl 2-hydroxy-3-nitropropionate was converted to methyl 3-nitroacrylate by treatment with acetyl chloride and subsequent thermal decomposition of the resulting ester.

$$\underset{NO_2\ OH}{CH_2{-}CH{-}CO_2CH_3} + CH_3COCl \rightarrow \underset{NO_2}{CH{=}CH{-}CO_2CH_3} + CH_3CO_2H$$

Methyl 3-nitroacrylate was hydrolyzed by dilute aqueous acid to 2-hydroxy-3-nitropropionic acid; this product was identical with that prepared by condensation of nitromethane and glyoxylic acid.

$$\underset{NO_2\ OH}{CH_2{-}CH{-}CO_2CH_3} \xrightarrow[H_2O]{H^+} \underset{NO_2\ OH}{CH_2{-}CH{-}CO_2H}$$

$$CH_3NO_2 + O{=}\underset{H}{C}{-}CO_2H \xrightarrow{OH^-} \underset{NO_2\ OH}{CH_2{-}CH{-}CO_2H}$$

Nitryl chloride and methyl acrylate react at 0° to give methyl 2-chloro-3-nitropropionate (75 percent), methyl 2, 3-dichloropropionate (7 percent), and dimethyl 2-chloro-4-nitromethylpentanedioate (5-10 percent).

$$CH_2{=}CH{-}CO_2CH_3 + NO_2Cl \rightarrow \underset{NO_2\ Cl}{CH_2{-}CH{-}CO_2CH_3} +$$

$$\underset{Cl\ \ Cl}{CH_2{-}CH{-}CO_2CH_3} + O_2N{-}CH_2{-}\underset{CO_2CH_3}{\overset{H}{\underset{|}{C}}}{-}\underset{Cl}{CH{-}CO_2CH_3}$$

Methyl 2-chloro-3-nitropropionate was converted to methyl 3-nitroacrylate, identical with that obtained from dinitrogen tetroxide and methyl acrylate, by dehydrochlorination with sodium acetate.

$$\underset{NO_2\ Cl}{CH_2{-}CH{-}CO_2CH_3} + NaC_2H_3O_2 \rightarrow$$

$$\underset{NO_2}{CH{=}CH{-}CO_2CH_3} + NaCl + C_2H_4O_2$$

The structure of dimethyl 2-chloro-4-nitromethylpentanedioate was determined by hydrolysis and reduction to yield glutaric acid.

$$O_2N{-}CH_2{-}\underset{CO_2CH_3}{\overset{H}{\underset{|}{C}}}{-}CH_2{-}\underset{Cl}{CH{-}CO_2CH_3} \xrightarrow[2.\ HI]{1.\ H^+,\ H_2O}$$

$$HO_2C{-}CH_2{-}CH_2{-}CH_2{-}CO_2H$$

Nitryl chloride and glacial acrylic acid react at 0° to give principally 2-chloro-3-nitropropionic acid (65-71 percent).

$$CH_2{=}CH{-}CO_2H + NO_2Cl \rightarrow \underset{NO_2\ Cl}{CH_2{-}CH{-}CO_2H}$$

Dehydrohalogenation of 2-chloro-3-nitropropionic acid with sodium acetate yielded 3-nitroacrylic acid; hydrolysis of 3-nitroacrylic acid gave 2-hydroxy-3-nitropropionic acid.

$$\underset{NO_2\ Cl}{CH_2{-}CH{-}CO_2H} \xrightarrow{NaC_2H_3O_2} \underset{NO_2}{CH_2{=}CH{-}CO_2H} \xrightarrow{H^+,\ H_2O}$$

$$\underset{NO_2\ OH}{CH_2{-}CH{-}CO_2H}$$

Nitryl chloride and acrylonitrile react at 0° to give 2-chloro-3-nitropropionitrile (76 percent) and 2,3-dichloropropionitrile (13.5 percent).

$$CH_2{=}CH{-}CN + NO_2Cl \rightarrow \underset{NO_2\ Cl}{CH_2{-}CH{-}CN} + \underset{Cl\ \ Cl}{CH_2{-}CH{-}CN}$$

The structure of 2-chloro-3-nitropropionitrile was proven, after conversion to 3-nitroacrylonitrile with sodium acetate, by hydrolysis to 3-nitroacrylamide and subsequent reaction with nitrous acid to give 3-nitroacrylic acid.

$$\underset{NO_2\ Cl}{CH_2{-}CH{-}CN} + NaC_2H_3O_2 \rightarrow \underset{NO_2}{CH{=}CH{-}CN} \xrightarrow{H^+,\ H_2O}$$

$$\underset{NO_2}{CH{=}CH{-}CONH_2} \xrightarrow{HNO_2} \underset{NO_2}{CH{=}CH{-}CO_2H}$$

Dinitrogen tetroxide is capable of heterolytic dissociation by two processes to produce nitronium, nitrite, nitroso and nitrate ions, or of homolytic dissociation to yield nitrogen dioxide.

$$N_2O_4 \rightleftharpoons NO_2^+ + NO_2^-$$

$$N_2O_4 \rightleftharpoons NO^+ + NO_2^-$$

$$N_2O_4 \rightleftharpoons \cdot NO_2 + \cdot NO_2$$

Physical measurements to prove the existence of ionic species in liquid dinitrogen tetroxide or in solution with ether-ester type solvents are nonconclusive; however, the existence of nitrogen dioxide has been proven. Any mechanism which postulates initial dissociation, or dissociation induced during reaction of dinitrogen tetroxide into ionic species is incapable of explaining the orientation observed for additions to methyl acrylate.

Nitryl chloride is capable of heterolytic or homolytic dissociation as follows:

$$NO_2Cl \rightleftharpoons NO_2^+ + Cl^-$$

$$NO_2Cl \rightleftharpoons NO_2^- + Cl^+$$

$$NO_2Cl \rightleftharpoons \cdot NO_2 + \cdot NO_2$$

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The similar orientations observed in additions of nitryl chloride to acrylic systems vinyl bromide and unsymmetrical alkenes indicate that orientation is not determined by the electronic demands of these systems.

It is therefore proposed that addition of both dinitrogen tetroxide and nitryl chloride to acrylic systems occurs by a homolytic process in which initial attack by nitrogen dioxide (or N_2O_4 or NO_2Cl) at the terminal position occurs exclusively by C–N attachment.

$$CH_2{=}CH{-}CO_2CH_3 + \cdot NO_2 \ (N_2O_4 \text{ or } NO_2Cl) \longrightarrow CH_2(NO_2){-}\dot{C}H{-}CO_2CH_3$$

In additions of dinitrogen tetroxide, this intermediate radical undergoes subsequent reaction by either C–O or C–N attachment to yield vicinal nitro-nitrite or dinitro adducts and nitrogen dioxide

$$CH_2(NO_2){-}\dot{C}H{-}CO_2CH_3 + N_2O_4 \longrightarrow CH_2(NO_2){-}CH(ONO){-}CO_2CH_3 +$$

$$CH_2(NO_2){-}CH(NO_2){-}CO_2CH_3 + \cdot NO_2$$

with nitryl chloride, the intermediate radical may react by exchange with nitryl chloride to yield chloronitro compound and nitrogen dioxide.

$$CH_2(NO_2){-}\dot{C}H{-}CO_2CH_3 + NO_2Cl \longrightarrow CH_2(NO_2){-}CH(Cl){-}CO_2CH_3 + \cdot NO_2$$

The orientations reported for addition reactions of dinitrogen tetroxide and nitryl chloride to other olefinic systems may also be explained by a "radical" mechanism.

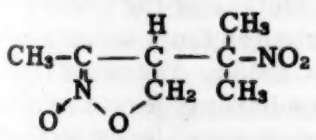
Section II. - New Reactions of Nitroalkyl Halides and Salts of Nitroalkanes.

The purpose of this research was to study the use of nitroalkyl halides of the general type

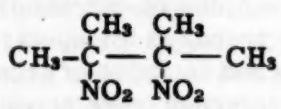
$$R{-}C(NO_2){=}CH{-}CH_2X \qquad R = H \text{ or Alkyl}$$

as alkylating agents for salts of nitroalkanes. The study includes reactions of 1-chloro-3-nitro-2-butene and 3-chloro-1-nitro-1-propene with sodium 2-nitropropane.

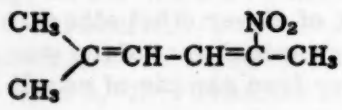
1-Chloro-3-nitro-2-butene and sodium 2-nitropropane in absolute ethanol at -20° react to yield 3-methyl-4-(2-nitro-2-propyl)-isoxazoline oxide, (I), (35-40 percent), 2,3-dimethyl-2,3-dinitrobutane, (II), (10-12 percent), and 5-methyl-2-nitro-2,4-hexadiene, (III), (3-5 percent).



(I)

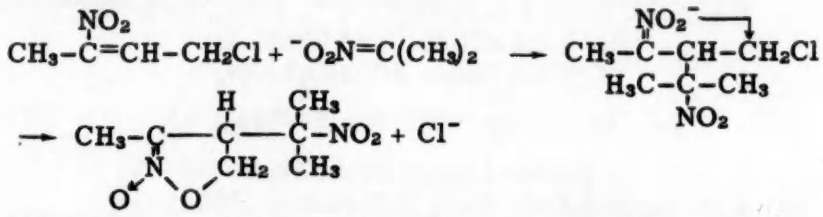


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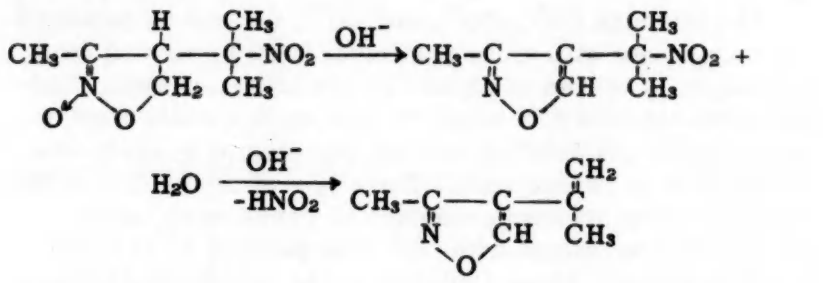


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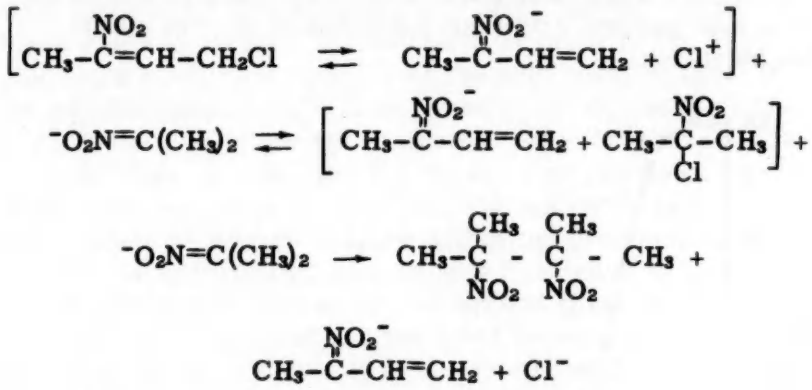
3-Methyl-4-(2-nitro-2-propyl)-isoxazoline oxide results from addition of sodium 2-nitropropane to 1-chloro-3-nitro-2-butene followed by internal cyclic displacement of chlorine.



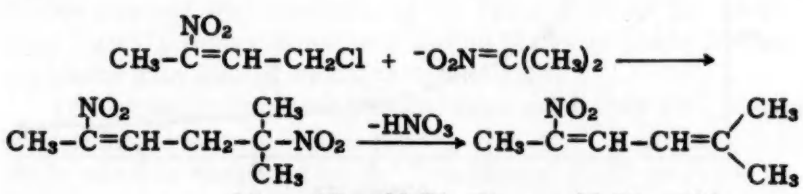
The structure of 3-methyl-4-(2-nitro-2-propyl)-isoxazoline oxide was determined from physical properties, its infrared spectrum, and conversion by dilute alkali to 3-methyl-4-(2-nitro-2-propyl)-isoxazole and 3-methyl-4-(2-isopropenyl)-isoxazole.



2,3-Dimethyl-2,3-dinitrobutane may result from exchange of halogen between 1-chloro-3-nitro-2-butene and sodium 2-nitropropane in the following manner:



5-Methyl-2-nitro-2,4-hexadiene results from carbon alkylation reaction of 1-chloro-3-nitro-2-butene and sodium 2-nitropropane followed by elimination of nitrous acid.



Microfilm $2.50; Xerox $6.20. 130 pages.

Abstract published by special arrangement with The Ohio State University.

I. CARRIER FREE SEPARATION OF COBALT. II. THE DISINTEGRATION OF THE RADIOACTIVE ISOTOPES Co^{56}, Co^{57}, AND Co^{58}. III. CHEMICAL ANALYSIS BY CYCLOTRON ACTIVATION.

(L. C. Card No. Mic 59-5374)

James Liggett Dick, Ph.D.
The Ohio State University, 1953

I. Carrier Free Separation of Cobalt

Two methods for preparing carrier free samples of cobalt used in nuclear spectroscopic studies were developed.

The isotopes Co^{56}, Co^{57}, and Co^{58}, formed by bombarding manganese with alpha particles, were separated from the target by means of alpha-nitroso beta-naphthol. Studies were conducted in which the optimum contact time between the target solution and the complexing reagent was established to be one hour. The effect of the acidity of the target solution on the percentage of complexing taking place was determined with both a 50 percent acetic acid solution and an aqueous solution of the complexing reagent. With a 50 percent acetic acid solution of the reagent, greater than 98 percent of the activity was removed if the acid concentration of the solution was maintained between .0001N and .25N. The percent of complexing taking place with a 50 percent acetic acid solution of the reagent is shown in Fig. 1.

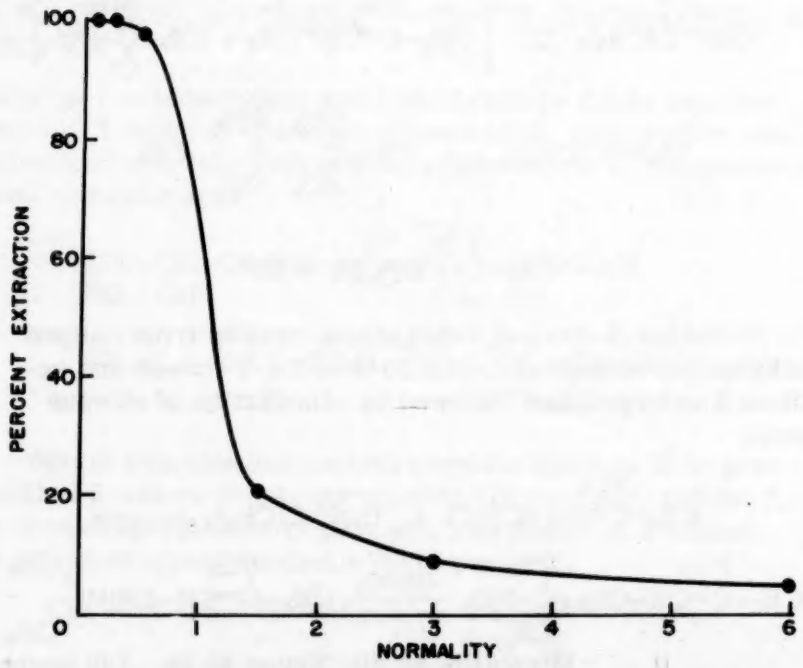


Figure 1. Effect of Acidity of Target Solution on Benzene Extraction of Cobalt Using a 50% Acetic Acid Solution of Alpha-Nitroso Beta-Naphthol

An additional study was conducted with an aqueous solution of the complexing reagent. In this case the acidity of the target solution was a more critical factor, for maximum complexing, approximately 98 percent, took place between pH 4.7 and 6.2. The sensitivity of the reaction to pH is shown in Fig. 2.

In conjunction with these studies, it was established that very small quantities of alpha-nitroso beta-naphthol were sufficient to remove the cobalt. For example, 1/2 ml of a solution containing 30 milligrams of the complexing

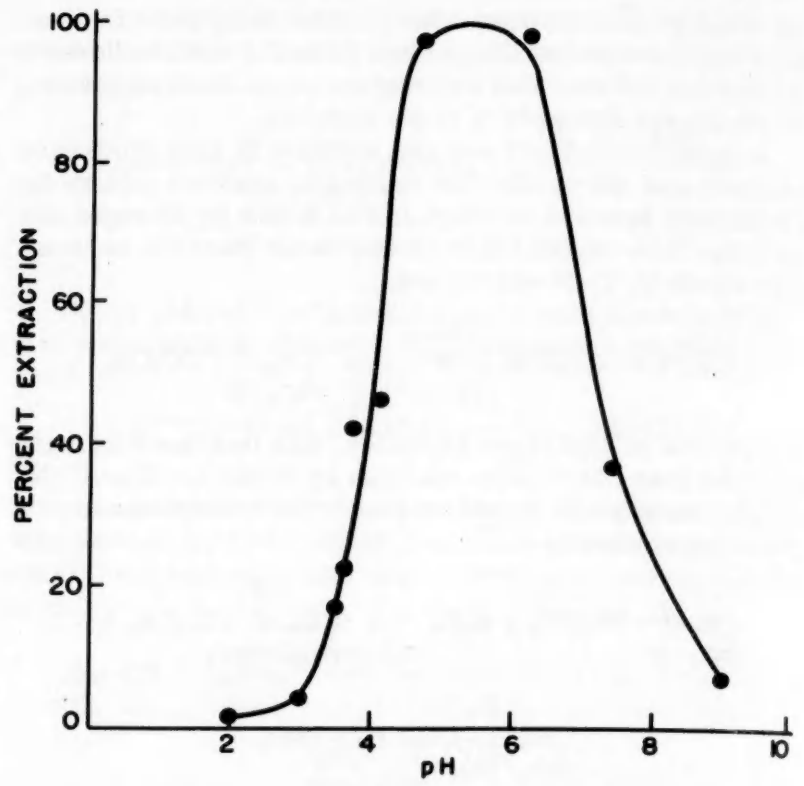


Figure 2. Effect of pH of Solution on Benzene Extraction of Cobalt Using an Aqueous Solution of Alpha-Nitroso Beta-Naphthol

reagent in 100 ml of water added to 25 ml of .1M manganous chloride (target solution) would form a complex with as much as 98 percent of the cobalt. Benzene was selected as the organic solvent for extracting the complex from the solution, thus avoiding the problems associated with filtration and ashing of the filter paper.

The following chemical procedure, based on the experiments described above, was developed:

The manganese target is treated with several portions of equilibrium hydrochloric acid until the sample is completely converted to the chloride. The solution is evaporated to dryness and redissolved in a quantity of triple distilled water such that the final solution is approximately .1M in salt content. The acidity of the solution is adjusted to pH 5.5. It is then heated to 80 degrees centigrade and 1/2 ml of an aqueous solution of alpha-nitroso beta-naphthol is added. After standing one hour the solution is transferred to a separatory funnel and extracted with benzene. The benzene phase is evaporated to dryness and the residual complex is burned in air, converting the cobalt to the oxide. This invisible sample is transferred to the spectrometer mount by means of hydrochloric acid.

Samples of carrier free Co^{56}, Co^{57}, and Co^{58} were also prepared for spectroscopic studies from targets of enriched isotopes of iron in ferric oxide. These radioactive isotopes were produced by bombarding ferric oxide with molecular protons (H_2^+). Experimental investigations were conducted in which the iron was removed from the solution as hydrous ferric oxide or extracted as ferric chloride by means of either ethyl ether or isopropyl ether.

The following chemical procedure was developed for preparing a carrier free sample of cobalt from a ferric oxide target:

The target is dissolved in a small quantity of 6N hydrochloric acid and treated with a few drops of bromine water to convert all the iron to the ferric state. The solution is

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

evaporated to dryness, redissolved in 6N hydrochloric acid, chilled to 5°C, and transferred to a separatory funnel along with an equal volume of chilled ethyl ether. The two phases are shaken together and the aqueous phase, containing the radioactive cobalt and some iron, is extracted. The aqueous phase is then evaporated to near dryness and then diluted to 25 ml with triple distilled water, and the pH is adjusted to 1.5. After heating, dilute ammonium hydroxide is added until the pH is approximately 3.5. The hydrous ferric oxide precipitate is removed by filtration. The filtrate is evaporated to dryness and the ammonium chloride volatized. The small residue remaining is dissolved in 1 ml of very dilute hydrochloric acid; ammonium hydroxide is then added until the pH of the solution is approximately 8.5. The hydrous ferric oxide formed is removed by filtration. The filtrate when evaporated to dryness contains an invisible quantity of the radioactive cobalt suitable for spectroscopic studies.

Two methods have been developed for preparing carrier free samples of cobalt, the separation of cobalt from a manganese target by means of alpha-nitroso beta-naphthol and the separation of cobalt from a ferric oxide target by means of partial ether extraction of ferric chloride followed by precipitation of the remaining iron as hydrous ferric oxide.

II. The Disintegration of Co^{56}, Co^{57}, and Co^{58}.

Three instruments were selected to aid in the investigation of these three isotopes, a thick lens spectrometer, a solenoidal spectrometer, and a scintillation spectrometer.

By selecting a target of ferric oxide enriched in Fe^{56} (99.81 percent Fe^{56}) for proton bombardment, it was possible to study the low energy portion of its spectrum without interference from the emissions of Co^{57} and Co^{58}. A careful study of the beta spectrum showed it to be complex, to be composed of two components with end point energies of 1.50 Mev and .44 Mev respectively. A momentum-energy distribution plot shows the main component to be present to about 96 percent and the low energy component to about 4 percent.

The photoelectron spectrum of Co^{56} was measured in the thick lens spectrometer with a uranium radiator that weighed 70 mg/cm^2. Seven gamma rays (nine peaks) were observed: .55 Mev, the positron annihilation radiation, .835 Mev (K line), .840 Mev (L line), 1.22 Mev (K line), 1.24 Mev (L line), 1.74 Mev, 2.31 Mev, 2.61 Mev, and 3.25 Mev.

The gamma rays emitted by Co^{56} were also studied by means of a scintillation spectrometer.

A partial decay scheme of Co^{56} is shown in Fig. 3. Co^{56} decays by the emission of two positron groups having end point energies of 1.50 Mev and .44 Mev respectively. The 1.50 Mev group decays to a second excited level 2.08 Mev above the ground level, which in turn decays to the ground state by the emission of two successive gamma rays of 1.24 Mev and .84 Mev respectively. With 1.50 Mev as the end point energy of the positron emitted and a half life of 76 days, a log ft value of 8.4 is obtained, making the transition first forbidden. From the shell model, Co^{56} is $f_{7/2} - p_{3/2}$ and the spin 5. It is reasonable to assume that the parity is odd, since as indicated in Fig. 3, the first and second levels of the daughter, Fe^{56}, can be assumed to be +2 and +4 respectively. Therefore the decay characteristics of the positron of Co^{56} may be $\Delta I=1$,Yes. Thus the log

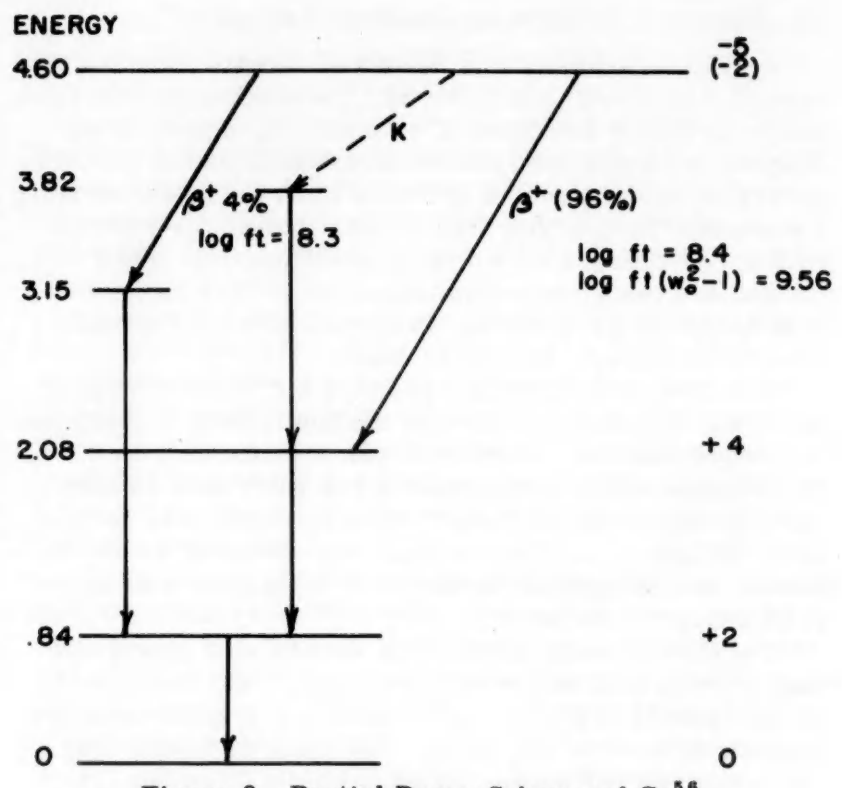


Figure 3. Partial Decay Scheme of Co^{56}

ft value lies in the region of about 6.5 and the transition is first forbidden. The possibility of $\Delta I=2$,Yes for which the log ft value is above 8 is eliminated because of the Fermi plot being linear and because of the spin assignments. If the ground state of Co^{56} is assumed to be -2, the high energy component of the spectrum will have the characteristic $\Delta I=2$,Yes. In this case the log ft value can be calculated from the formula log ft (W_0^2-1), which gives 9.56. On the basis of an energy balance within the proposed decay scheme, it appears that the .44 Mev $\beta+$ decays to a third excited level 3.15 Mev above the ground level, which in turn decays to the first excited level by emission of a 2.31 Mev gamma ray and finally to the ground state by the emission of a .84 Mev gamma ray. Since the analysis of the beta spectrum did not reveal the presence of the .99 Mev $\beta+$, it can be assumed that the 1.74 Mev gamma ray is preceded by K capture only and decays to the second excited state 2.08 Mev above the ground level.

No attempt was made to fit the remainder of the gamma rays into the decay scheme because the only basis for assignment was that of relative intensities.

The experimental conditions were such that Co^{57} could be investigated only in the presence of Co^{56}, for the ferric oxide sample enriched in Fe^{57} contained 45.69 percent Fe^{56} and 53.53 percent Fe. The Fermi plot of Co^{56} was subtracted from the plot of $Co^{56,57}$ in hopes that the resulting curve would reveal the contribution made by Co^{57} alone. A positron with an end point energy of .44 Mev was detected. Further study was limited because of poor resolution of the instrument and insensitive current control.

Similar to the preceding cases, Co^{58} could only be investigated with Co^{56} enriched by 23.4 percent Fe^{58} and 70.4 percent Fe^{56} present as the target. However, a positron with an end point energy of .48 Mev, previously assigned to Co^{58}, was confirmed. The first excited state of Co^{58} was determined to be +2. This was established from the intensity of the .810 Mev gamma ray measured by conversion electron studies. The $K/\beta+$ was found to be 6.0.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

III. Chemical Analysis by Cyclotron Activation

Activation analysis was developed shortly after the discovery of artificial radioactivity. Its importance lies in its ability to detect quantities of elements too minute to be discovered by standard analytical methods and in the freedom from interference it provides from elements not being measured. The sample may be activated by bombarding with either charged particles or neutrons. The latter method has had greater application since it is better fitted to quantitative procedures. Both qualitative and quantitative measurements have been made.

The studies made in this phase of the work were qualitative and designed to increase the application of cyclotron activation analysis. Beryllium was detected in a beryllium-copper alloy by bombarding the alloy with 15 Mev alpha particles for one hour. An α,2n reaction on beryllium yielded C^{11}. This isotope was detected by its 21 minute half life and the emission of a positron with an end point energy of .99 Mev.

The second study involved the detection of nickel and copper in an ore. Since the investigation was designed to set up conditions for activation analysis, a spectrographic analysis of the ore was made. The trace elements copper, chromium, nickel, boron, cobalt, gallium, zinc, lead, and vanadium were found. In addition, the more common elements found in most ores, iron, silicon, silver, magnesium, calcium, aluminum, and manganese were present. By means of this information and Sullivan's Chart, conditions were established that would aid in the detection of nickel and copper without interference from other elements. It was decided to bombard the ore for thirty minutes with 7 Mev protons. The decay was measured through aluminum absorbers capable of absorbing all beta particles of energies less than 1.8 Mev, 2.3 Mev, and 3.3 Mev respectively. By subtracting the curve obtained by counting through a 2.3 Mev absorber from the curve obtained by counting through a 3.3 Mev absorber, the characteristic decay curve of Cu^{62} resulting from a p,n reaction with Ni^{62} was detected. In a similar manner the difference of the counting rates recorded through a 1.8 Mev absorber and a 2.3 Mev absorber revealed the decay curve of Zn^{63}, a 38 minute half life, resulting from a p,n reaction with Cu^{63}. Thus it was possible to detect both nickel and copper in the presence of many other elements by cyclotron activation.

Microfilm $2.50; Xerox $6.60. 136 pages.

Abstract published by special arrangement with The Ohio State University.

SOME PROBLEMS IN THE THEORY OF COLLOIDS: I. A MECHANISM FOR NON-NEWTONIAN FLOW IN SUSPENSIONS OF RIGID SPHERES. II: CONCENTRATION DEPENDENCE OF THE VISCOSITY OF SUSPENSIONS. III. POTENTIAL AROUND A CHARGED COLLOIDAL SPHERE.

(L. C. Card No. Mic 59-5988)

Thomas John Dougherty, Ph.D.
Case Institute of Technology, 1959

I. A Mechanism for Non-Newtonian Flow in Suspensions of Rigid Spheres

A mechanism is postulated to account for non-Newtonian flow in rigid sphere suspensions. On the basis of this mechanism, the flow equation $(\eta - \eta_\infty)/(\eta_0 - \eta_\infty) = (1 - \tau/\tau_\xi)^{-1}$ is derived, where η is the viscosity at the shear stress τ, η_0 and η_∞ are limiting values of η at zero and infinite shear, respectively, and τ_ξ is a parameter determined by temperature and particle size. This equation correlates well with published data on latex and polymer systems.

II. Concentration Dependence of the Viscosity of Suspensions

A new viscosity vs. concentration function is derived for rigid particle suspensions by modification of the analyses of Brinkman, Roscoe and Mooney. The equation, $\eta_r = (1 - \phi/p)^{-p}[\eta]$, where η_r is the relative viscosity, $[\eta]$ the intrinsic viscosity, ϕ the volume fraction of suspended phase, and p the volume fraction at close-packing, correlates well with published data on synthetic latex and glass sphere suspensions.

III. Potential Around a Charged Colloidal Sphere

An approximate solution to the Poisson-Boltzmann equation which reduces to the Debye-Huckel and flat plate results in the proper limits was developed. The calculated potentials and surface charge densities compare favorably with those calculated by Hoskin by numerical integration. Microfilm $2.50; Xerox $3.60. 65 pages.

A STUDY OF THE DEPENDENCE OF MICELLAR STRUCTURE ON THE SHAPE OF DETERGENT MONOMER

(L. C. Card No. Mic 59-5511)

Esmond Eugene Drott, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Robert V. Nauman

The properties of detergents have been the subject of many investigations. For this investigation a series of psuedo-isomeric cationic detergents was synthesized and the effect of this isomerism on micellar molecular weight, critical concentration and solubilization studied. Micellar weights and critical concentration of the detergents were determined by light scattering in aqueous and salt solutions.

The solubilization of benzene and its effect on micellar size was also investigated.

The compounds prepared in this study were: n-tetradecyltrimethylammonium bromide (I), ω(β-naphthyl)-butyltrimethylammonium bromide (II), ω(β-tetryl)-butyltrimethylammonium bromide (III), β(ρ-phenylphenyl)-ethyltrimethylammonium bromide (IV), and β(ρ-cyclohexylphenyl)-ethyltrimethylammonium bromide (V).

Critical micelle concentrations of the detergents in salt solutions decreased with increasing salt concentration with the data fitting a series of straight lines when plotted as ln $(c_o + c_{salt})$ vs ln (c_o). Compounds II and III had critical concentrations that were identical. A correlation was found between log (c_o) and the area of the hydrophobic part of the detergent as determined from Fischer-Hirschfelder atomic models.

The micellar molecular weight of I increased from 27,000 in water to 59,000 in 0.050 M NaBr. The weights of II and III were 25,000 and 47,000. Because of the high critical concentration of II and III, their micellar weights did not increase in salt solutions. Compound IV had a weight of 20,000 in water. Compound V precipitated upon reaching its critical concentration in aqueous and salt solutions.

It was found that some time was required for the turbidities to reach a final stable value when a detergent with an impurity in it was diluted to a concentration below c_o. The rate controlling step may be the dissociation of the micelle or agglomeration of the insoluble impurity.

The amount of benzene solubilized by the detergents varied considerably. The order of solubilizing power for the detergents was I > III > IV with II solubilizing very little and V none. The increase in micellar weights when benzene was solubilized was found to follow the same order.

Calculations based upon volume-area relationships of molecular models and detergent data indicate that a spherical shaped micelle is possible for the normal alkyl detergents. In the case of the cyclic detergents, a spherical model could not be formed due to the configuration of the hydrocarbon chains unless a small amount of impurity was present. A relationship between the type of polar head and solubilizing power of the detergent was postulated.

Microfilm $2.50; Xerox $7.00. 146 pages.

THE MECHANICAL BEHAVIOR AND MICROSTRUCTURE OF IMPACT RESISTANT THERMOPLASTICS

(L. C. Card No. Mic 59-5970)

Robert M. Evans, Ph.D.
Case Institute of Technology, 1959

This research examined a variety of industrially important structural plastics with the objective of defining the general physico-chemical conditions which distinguish tough from brittle plastics in terms of laboratory methods which can be used conveniently to guide the plastics compounder in the design of impact resistant materials.

The first step was to replace the somewhat arbitrary and inconvenient falling weight tests as a measure of quality with a more useful measure of the ultimate properties of tensile strength, elongation, and energy of rupture. Tensile curves at speeds of 3.33×10^{-3}, 3.33×10^{-2}, and 3.33×10^{-1} inches per second were studied and a method was also developed for approximating elongation and rupture energy at 235 inches per second. As the rate increased, the correlation improved until a linear correlation between falling weight energy and tensile curve energy was in effect at 0.333 inches per second. The estimated high speed tensile energy showed as good a linear correlation with falling weight data as did the 0.333 inch per second tensile data.

In general, impact resistant plastics which have rupture energies in the range of 100-2000 inch lb./in.^{3} can be classified into two categories: Class I--the fiber reinforced thermosetting plastics having low ductility but tensile strengths of more than 25,000 psi, and Class II--some rigid thermoplastics having moderate tensile strengths of 8,000 psi or less but an extensive elongation capacity beyond the yield point.

Since Class I plastics are an adhesive blend of polymer with very high tensile strength fibers, their impact resistance can be attributed to the fiber fillers. Greater theoretical difficulties come in explaining impact resistance in Class II materials. Older theories suggest the non-discriminative molecular models for materials of both the impact resistant and brittle type. The inadequacy of the older theories motivated a search for other structural features which can promote the differences in tensile properties which distinguish ductile from glassy thermoplastics.

Using special replica techniques of electromicroscopy, examination of fracture surfaces of samples quenched to -60°C from room temperature disclosed that a microstructure existed in all the impact resistant plastics which was absent in homogeneous plastics which are brittle at room temperature. This suggested that some special type of phase heterogeneity may be one of the necessary conditions for high impact resistance. Further confirmation of this hypothesis was obtained indirectly by comparison of some structure sensitive mechanical properties.

The assumption that the microscopically observed structure in Class II plastics was associated with phase heterogeneity was confirmed by using a dynamic test to measure the shear modulus and damping decrement as a function of temperature over the range of -60 to 200°C. The temperature functions showed deflections, which identify phase transitions, only for those plastics which showed an observable microstructure in fracture sections. Among the polyphase thermoplastics, the tensile properties identified with impact resistance prevailed in only those plastics for which the temperature-property functions derived from dynamic tests showed the coexistence at ambient temperature of at least one each of solid and rubbery phases.

Phase separation in polymer systems results ordinarily in a condition where one phase is dispersed in discrete domains within a continuous phase. The continuous phase is presumed to dominate the viscoelastic properties. Stress relaxation measurements at strains below and above the yield range were conducted to establish which was the dominant and most probably the exterior phase. For impact resistant thermoplastics, the stress versus time function showed a transition from glassy behavior at strains less than the yield value, to a rubbery stress relaxation behavior at strains above yield. This was true for both partially crystalline homopolymers and for mixtures of amorphous polymers despite the fact that theory predicts dissimilar phase structures in the two types of

plastics. If the stress relaxation data correctly identify which is the exterior phase, the presently held conclusions on phase structure are either incorrect or else more than one mechanism is necessary to explain the common features of high speed tensile properties in the dissimilar types of polyphase compositions which make up the Class II group of plastics. These uncertainties cannot be resolved until more versatile methods are developed for examination of the phase structure of polymers.

Microfilm $2.50; Xerox $7.40. 157 pages.

A STOCHASTIC THEORY OF FIRST ORDER PROCESSES

(L. C. Card No. Mic 59-5968)

Paul J. Gans, Ph.D.
Case Institute of Technology, 1959

This thesis describes an investigation of certain types of rate processes from a statistical point of view, in which a system is characterized by means of the population of cells in an appropriate space. Events in this space consist of changes in cell population and are governed by transition probabilities. A stochastic equation is set up representing the behavior of a system. This equation is then solved by generating function methods.

In Part I are discussed several problems in which the transition probabilities are linear in the occupation number of a single cell. These problems are:

(1) an elementary problem due Feller

(2) problems related to the Ehrenfest Urn Model

(3) generalizations of a problem due Klein

(4) the general chemical reaction

(5) 1-1 chemical reaction and diffusion

Of these (1) and (2) are well known in the literature, while (3), (4) and (5) are new in formulation or application.

A general first order problem in which the transition probabilities are directly proportional to a cell population number is formulated and solved in Part II. The solution of this general problem yields many of the results obtained in Part I, and is shown to be applicable to the solution of problems hitherto unsolved in the literature.

Microfilm $2.50; Xerox $5.00. 98 pages.

THE AUTOXIDATION OF DIPHENYLACETONITRILE

(L. C. Card No. Mic 59-5140)

Beverley Ross Garrett, Ph.D.
University of Delaware, 1959

Supervisor: Harold Kwart

The autoxidation if diphenylacetonitrile by molecular oxygen has been investigated. Studies were made on the effects of concentration, temperature, oxygen pressure, solvents, bases, salts and various catalysts and inhibitors and a rate equation formulated.

It was found that the rate of reaction was proportional to the concentration of diphenylacetonitrile, oxygen and sodium hydroxide. The use of other bases was also investigated and found to give different results than with sodium hydroxide. Salt effects and solvent effects were observed but there was no autocatalysis or catalysis by salts of heavy minerals. No induction period was noted and there was no inhibition on addition of diphenylamine or arsenic trioxide. Benzoyl peroxide did not accelerate the reaction and no surface catalysis was observed.

The activation energy for the reaction in tertiary butanol was approximately 10,000 calories and the high negative entropies (-43 e.u.) suggested a highly ordered transition state intermediate. There was no evidence of free radical formation or hydrogen peroxide formation followed by oxidation of the diphenylacetonitrile.

The products formed from the autoxidation reaction were benzophenone and sodium cyanate. Quantitative analysis demonstrated that the ketone and cyanate were essentially the only products formed. It was shown that the cyanide ion could not have been formed and subsequently oxidized to cyanate ion by molecular oxygen or hydrogen peroxide. Microfilm $2.50; Xerox $5.80. 119 pages.

INSTRUMENTAL STUDIES OF PORPHYRIN COMPOUNDS OBTAINED FROM PYRROLE ALDEHYDE CONDENSATIONS

(L. C. Card No. Mic 59-4618)

Jack M. Goldstein, Ph.D.
University of Pennsylvania, 1959

Supervisors: Wallace M. McNabb and J. F. Hazel

Porphyrin products from sealed tube condensation reactions between pyrrole and substituted benzaldehydes (Rothemund Mennotti reaction) were studied by I.R. spectroscopy and x-ray diffractometry in order to gain greater insight into porphyrin chemistry in general. Specifically, questions such as fine structure, metal to ligand bonding, and degree of aromaticity were investigated by correlating data from a large number of closely related compounds.

The products of each successful condensation reaction studied were subjected to extensive column chromatography, which usually resulted in the isolation of a pure porphine fraction, and a pure chlorin one. The respective yields of these vary depending on the aldehyde employed. It was found that with negatively substituted benzaldehydes, the chlorin fraction could be the major one. The maximum yield of any component was usually less than ten percent.

The I.R. studies were performed on a double beam instrument in the rock salt region making use of the KBr pellet technique. The x-ray diffractometer and the visible recording double beam spectrophotometer were conventional instruments. The results of the spectral studies indicate that the tetraphenylporphyrins, although showing many similarities to naturally occurring porphyrins, also differ in certain respects, and that caution need be exercised in applying conclusions obtained from physical studies of them to the porphyrin class as a whole.

The I.R. spectra show an interesting shift of certain absorption peaks that is dependent upon the metal chelated, and that this shift is usually proportional to the strength of the bond between the metal atom and the porphyrin ligand. Noteworthy in this respect, is the absorption band representing the stretching vibration of the C-N-C group in the pyrrole rings.

The problem of coplanarity of the phenyl groups with the porphine ring has been considered in the light of a possible resonance interaction between the two groupings. It was concluded that although the two groups are most likely not coplanar, there is still evidence of a strong resonance interaction which may be dependent upon an inductive effect for its propagation.

In terms of powder diffraction patterns, the tetraphenylporphyrins show marked deviation from the related phthalocyanines, in that a series of different metal derivatives of a given porphyrin ligand does not form an isomorphous series as the phthalocyanines do. It is concluded that the nature of the bonding in porphyrins between metal and nitrogen atoms may be significantly different from that of phthalocyanines, and also that the porphyrin molecule may be appreciably puckered in shape.

The evaluation of the major portion of data obtained in the study seems more compatable with a formulation of imino hydrogen atoms in dynamic equilibrium (tautomerism) than a static one where they might be considered to reside on a select nitrogen atom. This applies in the case of solutions only, there being evidence of hydrogen bonding in the solid state.

Microfilm $2.85; Xerox $9.80. 219 pages.

THE VISIBLE AND NEAR ULTRAVIOLET SPECTRA OF THE ALUMINUM MONOXIDE MOLECULE

(L. C. Card No. Mic 59-6198)

Vernon Wilson Goodlett, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor K. Keith Innes

In the present work all emission bands previously attributed to the AlO molecule have been observed in the glow from a hollow cathode containing Al-Al_2O_3 pellets. Because of the rather low pressure and temperature of the source, the bands have been photographed at higher dispersion and with much better resolution than had previously been attained. It has therefore been possible to analyze bands of systems at 4850 A, 3000 A, and 2500 A.

The 4850 A, $^2\Sigma$ - $^2\Sigma$ system has previously been studied in detail. An attempt was made to extend this system, but no new bands were observed. The rotational structure of the 0-0 band of this system was analyzed and the rotational constants derived were found to be in good agreement with those of previous workers. Because of the high resolution, it was possible to determine accurately the spin doubling constants for this band. The present work gives the following constants for the 0-0 band of the $^2\Sigma$ - $^2\Sigma$ system.

$B_o'' = .6385 \pm .0003\ cm^{-1}$ $\quad D_o'' = (1.089 \pm .11) \times 10^{-6}\ cm^{-1}$

$B_o' = .6019 \pm .0003$ $\quad D_o' = (1.148 \pm .11) \times 10^{-6}$

$\gamma' = .019 \pm .005$ $\quad \gamma'' = .008 \pm .006$

A large part of this work is concerned with the analysis of the 3000 A system. Both the vibrational and rotational structure shown by this band system are quite complex. The vibrational analysis indicates that the lower electronic state of this system is the same as the lower state of the $^2\Sigma$ - $^2\Sigma$ system. The lowest vibrational frequency of the lower electronic state was found to be 965.19 cm^{-1}. This is in excellent agreement with the value of 965.23 cm^{-1} for the lowest vibrational frequency of the lower electronic state of the $^2\Sigma$ - $^2\Sigma$ system. From the vibrational and rotational analyses, it was determined that the 3000 A system results from a $^2\pi$ - $^2\Sigma$ transition. Each band of the system is split into two distinct sub-bands. Rotational analyses were carried out on the following sub-bands: $(4\text{-}2)_2$, $(1\text{-}0)_2$, $(1\text{-}0)_1$, $(0\text{-}0)_1$, and $(0\text{-}1)_1$. The rotational analysis substantiates the conclusion that the lower electronic state is the same as the lower state of the 4850 A bands. The constants of the new state are

$\omega_e' = 728.28 \pm .25\ cm^{-1}$ $\quad \omega_e x_e' = 7.48 \pm .07\ cm^{-1}$

$B_e' = .6029 \pm .001$ $\quad \alpha_e' = .0036$

$A_1' = -74.66 \pm .15$ $\quad T_e' = 33175.40 \pm .30$

The bands at 2500 A are quite weak, and considerable difficulty was encountered in photographing them at high dispersion and high resolution. Only two bands of this system were observed with certainty. Their separation of 718 cm^{-1} indicates that one state of this system is the same as the $^2\pi$ state of the 3000 A system (713 cm^{-1} is observed in the 3000 A system). The rotational analysis of the band at 39983 cm^{-1} indicates that the 2500 A system arises from a $^2\pi$ - $^2\pi$ transition. The rotational analysis supports the assumption that one electronic state of this system is the $^2\pi$ state of the 3000 A system. The vibrational analysis of this system is somewhat uncertain. It indicates that the state in common with the $^2\pi$ - $^2\Sigma$ system is the lower state of the $^2\pi$ - $^2\pi$ system. Thus, only the constants for the upper electronic state of the $^2\pi$ - $^2\pi$ system are new. They are

$\omega_e' = 678\ cm^{-1}$ $\quad \omega_e x_e' = 3\ cm^{-1}$

$B_o' = .5559 \pm .002$ $\quad A_o' = -77.74$

$T_e' = 73173$

Since the $^2\pi$ state of the $^2\pi$ - $^2\Sigma$ system has a rather low dissociation energy, it sheds some light on the true dissociation energy of the molecule, i.e. the dissociation energy of the lowest electronic state of the molecule. From the $^2\Sigma$ - $^2\Sigma$ system, the dissociation energy of the lowest state of the molecule is determined by extrapolation of the vibrational levels as 4.2 e.v. The ground state is assumed to dissociate into normal atoms, i.e. atoms whose electronic energies are 0. The present work indicates that the $^2\pi$ state of the $^2\pi$ - $^2\Sigma$ system dissociates into atoms of 2.04 e.v. greater energy than the dissociation products of the ground state. The energy of the dissociation products of this $^2\pi$ state must be 0, 1.97, 3.14 e.v. (or

higher) greater than the dissociation products of the ground state of the molecule since combinations of Al and O atoms can only have energies of 0, 1.97, 3.14 e.v. (or higher). The good agreement of 2.04 with the value of 1.97 e.v. indicates that the spectroscopically determined dissociation energies are consistent and thus lends support to the value of 4.2 e.v. as the dissociation energy of AlO.

Microfilm $2.50; Xerox $6.80. 144 pages.

THERMODYNAMIC PROPERTIES OF POLYMERS IN RELATION TO THEIR STEREOCHEMICAL STRUCTURE

(L. C. Card No. Mic 59-4620)

Fred Gornick, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Robert E. Hughes

Part I

The Stereochemical Structure of Linear Polymers

The recent advent of stereospecific polymerization has made possible the synthesis of linear polymer chains possessing high degrees of isomeric regularity, i.e., long sequences of chain segments in which the steric arrangement of the immediately preceding segment is repeated (isotactic placement) or sequences of segments which alternate regularly in configuration (syndiotactic placement).

For chains which are less than completely ordered with respect to their steric arrangement, it is possible to describe the isomeric structure in terms of (1) the overall fraction of segments in isotactic placement and (2) the distribution of isotactic and syndiotactic sequence lengths. In the case of polymers containing truly asymmetric centers, (as opposed to the pseudoasymmetric centers found in vinyl polymers) specification of steric structure requires that isotactic sequences be distinguished in so far as absolute configuration is concerned, i.e., all d or all l.

Expressions for each of the above have been derived from a stochastic model in which the placement and/or the absolute configuration of a segment adding to a growing chain end are considered as statistical events dependent (in general) upon the outcome of preceding events (placements or configurations). It is shown that the parameters required to evaluate such expressions are uniquely determined by the free energies of activation for competing pairs of reactions at the growing chain end.

The effect of finite chain length on the stereosequence distributions is also considered and shown to be significant only in extreme special cases.

Part II

The Crystallization of Partially Tactic Systems

In principle, correlation of sequence distributions with observable physical properties would provide a check for proposed polymerization mechanisms. An obvious application of the distribution functions is an extension of Flory's theory of copolymer crystallization to cover the crystallization of stereospecific sequences.

Thus, utilizing existing theory, it is shown that both the melting point and equilibrium degree of crystallinity of a partially tactic polymer is dependent upon its stereosequence distribution. Similar analyses are carried out for such partially tactic systems as stereoblock polymers and mixtures of polymers differing in tacticity.

It is concluded that the most useful information relating to the tacticity of a polymeric system is obtained from an analysis of its equilibrium melting behavior over a range of temperature.

Part III

Statistical Thermodynamics of Partially Tactic Polymers

The influence of tacticity on the inherent chain stiffness of diluted and undiluted polymer molecules is considered from a statistical thermodynamic viewpoint. A lattice model recently developed by Flory for semi-flexible polymer chains is modified in order to account for the effect of possible differences in the flexibilities of isotactic and syndiotactic sequences, such differences arising from unequal barriers to rotation about the primary valence bonds within each type of sequence.

It is shown that the free energy expression resulting from the lattice partition function is a linear function of the tacticity for a given molecular weight and for given sequence flexibilities. In the limit of complete tacticity the free energy expression becomes identical with that previously derived by Flory. The major effects of chain inflexibility are modulated somewhat by the segregation of segments into sequences differing in flexibility. A comparison of the free energies of disorientation for chains of uniform and non-uniform flexibility shows that for a given overall degree of chain stiffness, the uniform chain is characterized by a higher (more positive) free energy.

The possible effect of tacticity on polymer-solvent interactions is considered for the case of partially tactic polymers of low flexibility. In such polymers, it is assumed that certain portions of the chain in solution are in energetically preferred conformations (generally helical) and that these will interact with the solvent to a greater or lesser extent than the coiled portions of the chain. In this case, the flexibility of the chain is a function of its dilution, in consequence of which the chemical potentials of mixing for both polymer and solvent are shown to depend upon the tacticity of the polymer chain.

Microfilm $2.50; Xerox $4.60. 87 pages.

PROPERTIES OF SOME 1:1 ELECTROLYTES IN AN AQUEOUS MEDIUM

(L. C. Card No. Mic 59-6066)

Sami Assad Halaby, Ph.D.
University of Cincinnati, 1959

The purpose of this work was the experimental investigation of the variation of electrical conductance and viscosity of 1:1 electrolytes with concentration. Further, the interpretation of the results in light of modern interionic theory of conductance and the Eyring theory of "holes in liquid" have also been considered.

Measurements were, therefore, undertaken at proper concentration intervals of the electrical conductance and viscosity of aqueous solutions of sodium nitrate, sodium bromide, lithium bromide, and lithium iodide covering most of their solubility range and at a temperature of 0°, 25°, and 50°C. In addition, measurements of the ultraviolet absorption spectra and the proton magnetic-resonance shift were also carried out on these solutions.

The specific conductance-molality curves for the four salts exhibit maxima in the concentration range 6.5 to 7.8 m. These maxima are related to the hydrated structure of the ions in solution. The equivalent conductance-normality curves for all four salts are very nearly linear at high concentrations. The equivalent conductance-concentration curve for lithium bromide seems to approach a common limit with that of lithium chloride as the concentration increases. This limit is higher for these two lithium salts than that of sodium salts of comparable concentration. Calculation of the equivalent conductance by the Wishaw-Stokes equation and comparison of $\mathring{a}$ (distance of closest approach of the ions) parameter with that proposed from x-ray structural determination indicates that little physical significance can be attached to the value of $\mathring{a}$ beyond the fact that it gives the correct order of magnitude.

By use of Eyring's "holes in liquid" theory the viscosity data are used to evaluate the heat of activation of viscous flow and the entropy of activation of viscous flow. Values for the entropy of activation of viscous flow are regarded as measuring the extent of "short-range local order" in solution. These values decrease with increase in concentration for the initial part of the concentration range but subsequently start to increase again at higher concentrations. From this behavior it is inferred that sodium salts start to exhibit "short-range local order" at lower concentrations than do lithium salts.

Sodium nitrate solutions have an ultraviolet absorption band in the neighborhood of 300 mμ. A test of Beer's law is carried out with the data obtained. A band in the neighborhood of 300 mμ was also observed for sodium and lithium bromide solutions but its origin is yet uncertain.

Variation of the proton magnetic-resonance shift with concentration was found to be very nearly linear up to concentrations of 5 m. The shift-concentration curve of all the salts studied (with the exception of lithium iodide solutions) turn upward at the higher concentrations. The behavior of these curves is explained in terms of both the hydrogen bond-breaking ability and the polarizing ability of the ions. Microfilm $2.50; Xerox $6.60. 137 pages.

HIGH TEMPERATURE ALLOTROPY OF THE RARE-EARTH ELEMENTS

(L. C. Card No. Mic 59-5668)

Joseph John Hanak, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: A. H. Daane

An investigation of the rare-earth metals was made by high temperature X-ray methods in order to determine their high temperature allotropy and thermal expansion characteristics. The high temperature structure of several of these metals was found to be body centered cubic (bcc). The bcc lattice constants, above the transformation temperatures reported by Spedding and his co-workers, are the following: lanthanum, 4.26 $\mathring{A}$ above 868°C; cerium, 4.12 $\mathring{A}$ above 730°C; praseodymium, 4.13 $\mathring{A}$ above 798°C; neodymium, 4.13 $\mathring{A}$ above 868°C; ytterbium 4.44 $\mathring{A}$ above 798°C. Some evidence was obtained for a bcc structure in gadolinium above 1262°C, the lattice constant being 4.06 $\mathring{A}$.

Below their respective transformation temperatures given above, lanthanum and cerium are face centered cubic (fcc), whereas praseodymium and neodymium are hexagonal (double c-axis). At 292°C lanthanum transforms completely into the fcc phase, however, below this temperature both the fcc and the hexagonal (double c-axis) structures coexist.

Ytterbium retains its fcc structure up to the transformation temperature of the bcc phase, however, it is possible to stabilize a hcp structure above 260°C by introducing atmospheric impurities. Above 720°C this phase transforms into the bcc phase. The lattice constants for the hcp phase at 268°C, are a = 3.911 $\mathring{A}$ and c = 6.403 $\mathring{A}$ with c/a = 1.637. Atmospheric impurities lower the fcc-bcc transformation temperature by as much as 80°.

Gadolinium and lutetium were found to be hcp up to at least 1200°C and 1400°C, respectively. Scandium, yttrium, and the remaining trivalent heavy rare-earth metals are also hcp to at least the vicinity of 950°C.

Electrical resistivity measurements confirmed crystalline transformations in gadolinium near 1262°C and in terbium near 1316°C and gave evidence for additional transformations in terbium between 1005°C and 1115°C, in dysprosium between 1383°C and 1400°C, in holmium between 1435°C and 1450°C, and in lutetium between 1260°C and 1407°C.

The axial ratio of the hexagonal metals increases with increasing temperature and it seems to attain a nearly constant value of 1.601 ± 0.001 at the transformation temperature of the rare-earth metals having the hcp structure. For metals having the hexagonal (double c-axis), this limiting axial ratio, 1/2 (c/a) is 1.619 ± 0.002.

Lattice constants were determined for scandium, yttrium and the rare-earth elements (excluding samarium) to temperatures as high as 1000°C. The data were fitted to empirical equations from which coefficients of expansion were calculated. In the case of the hcp metals, the c-axes expand more with increasing temperature than the a-axes by a factor ranging from 1.6 to 4.4.

Europium exhibits a sharply decreasing coefficient of expansion with increasing temperature in the investigated temperature range of 20°C to 300°C. This phenomenon might be due to a gradual promotion of one of the 4f electrons into the conduction band.

The hexagonal phases of lanthanum and ytterbium are larger in volume by 0.5 and 0.7 per cent, respectively, than the fcc phases. The transformations to the bcc structure are accompanied by small increases in volume for lanthanum, cerium, praseodymium, and neodymium, and small decreases for gadolinium and ytterbium.

Microfilm $2.50; Xerox $8.00. 173 pages.

THE THERMODYNAMICS OF CHELATION

(L. C. Card No. Mic 59-6435)

James Howard Holloway, Ph.D.
The University of North Carolina, 1959

Supervisor: Charles N. Reilley

The stability constants for the reaction between a series of divalent and trivalent metal ions with tetraethylenepentamine (tetren), cyclohexanediaminetetraacetic acid (CyDTA), diethylenetriaminepentaacetic acid (DTPA), ethyletherdiaminetetraacetic acid (EEDTA), ethyleneglycol bis-(β-aminoethyl ether)-N,N'-tetraacetic acid (EGTA), and N-hydroxyethylethylenediaminetriacetic acid (HEDTA) have been determined potentiometrically with a mercury electrode. The complexes studied were those of Hg-tetren^{++} (log K = 27.7), Cu-tetren^{++} (22.9), Ni-tetren^{++} (17.8), Zn-tetren^{++} (15.4), Cd-tetren^{++} (14.0), Pb-tetren^{++} (10-11), Mn-tetren^{++} (7.0), Bi-tetren^{+++} (>0), Ca-tetren^{++} (--), Mg-tetren^{++} (--), Sr-tetren^{++} (--), Ba-tetren^{++} (--), Al-tetren^{+++} (--), La-tetren^{+++} (--), Hg-CyDTA^{-2} (24.4), Ni-CyDTA^{-2} (19.4), Zn-CyDTA^{-2} (18.6), Ca-CyDTA^{-2} (12.3), Sr-CyDTA^{-2} (10.0), Hg-DTPA^{-3} (27.0), Zn-DTPA^{-3} (18.8), Cd-DTPA^{-3} (19.0), Mn-DTPA^{-3} (15.5), Pb-DTPA^{-3} (18.6), Ca-DTPA^{-3} (10.7), La-DTPA^{-2} (19.1), Hg-EGTA^{-2} (23.8), Cu-EGTA^{-2} (17.8), Ni-EGTA^{-2} (13.6), Co-EGTA^{-2} (12.3), Zn-EGTA^{-2} (14.5), Cd-EGTA^{-2} (16.7), Mn-EGTA^{-2} (12.3), Pb-EGTA^{-2} (14.6), Ca-EGTA^{-2} (10.9), Hg-EEDTA^{-2} (23.1), Ni-EEDTA^{-2} (14.7), Co-EEDTA^{-2} (14.7), Zn-EEDTA^{-2} (15.3), Pb-EEDTA^{-2} (14.4), Sr-EEDTA^{-2} (8.6), Hg-HEDTA^{-1} (20.1), Zn-HEDTA^{-1} (14.5), Pb-HEDTA^{-1} (15.5), Mg-HEDTA^{-1} (7.0), Sr-HEDTA^{-1} (6.8), Ba-HEDTA^{-1} (6.2). The reported log K values were obtained at 25.00 $\pm$ 0.02°C and at an ionic strength of 0.10. A new method of determining proton formation (acidity) constants of chelons is described. The method has been applied to tetraethylenepentamine.

Calorimetric heats of formation of divalent metal (copper, cadmium, nickel, and zinc) chelates of ethylenediaminetetraacetate, triethylenetetramine and tetraethylenepentamine have been measured in aqueous solution. The reported heats of formation values were obtained at 25.0°C and at a known ionic strength (0.30-0.45). The entropy changes associated with the formation of the metal chelate compounds were calculated from measured stability constants and heats of formation data. The high stability of the metal-ethylenediaminetetraacetate chelates is primarily due to the high positive entropy change, coupled with favorable heats of formation, which accompanies these reactions. The heats of formation of the metal-trien and metal-tetren chelates are greater than those of the corresponding metal-EDTA chelates. This increase is attributed to the increased binding energy of metal-nitrogen bonds versus metal-oxygen bonds.

The design of a calorimeter suitable for measuring heats of formation of metal chelate compounds and a new and simple procedure for these measurements are described. Microfilm $2.50; Xerox $6.00. 125 pages.

KINETICS OF THE IRON-HYDROGEN SULFIDE REACTION AT HIGH TEMPERATURES

(L. C. Card No. Mic 59-5520)

Lester Deurelle Hulett, Jr., Ph.D.
Louisiana State University, 1959

Supervisor: Professor Paul Delahay

The mechanism of the iron-hydrogen sulfide reaction was studied in the 500-760° temperature range for a total gas pressure of one atmosphere. The rate of attack was essentially constant (linear law), and the corrosion scale was composed of two layers: a thin dense layer adjacent to the metal and a porous layer with a coarse crystalline structure. These two features which differentiate this reaction from the iron-sulfur vapor reaction are interpreted on the basis of two main effects: (a) partial blocking of reaction sites by hydrogen produced during attack, and occurrence of a reaction at a constant number of reaction sites; and (b) continuous recrystallization of the dense scale into a porous scale offering no barrier to transport of reactants. This mechanism is self-regulating.

The following evidence is presented: (a) linear Arrhenius plots were obtained; (b) essentially the same rate of attack was observed for hydrogen-hydrogen sulfide and helium-hydrogen sulfide mixtures having the same partial pressure of hydrogen sulfide; and the dependence of rate on hydrogen sulfide pressure was accounted for; (c) the attack rate was not affected by the coating of specimens with a dense layer of varying thickness obtained by preliminary attack in sulfur vapor; (d) the iron-sulfur reaction, which obeys the parabolic law of attack, was inhibited by hydrogen diffusing from the back of the specimen surface; (e) recrystallization of the dense layer into the porous one was observed for specimens aged in helium.

Discussion of experimental methods covers the following points: (a) measurements of the rate of attack with a quartz spring balance in hydrogen-hydrogen sulfide and helium-hydrogen sulfide mixtures; (b) techniques for attack in sulfur vapor followed by hydrogen sulfide attack; (c) use of a mild steel cartridge containing lithium aluminum hydride in the hydrogen diffusion studies; (d) scale thickness studies.

Microfilm $2.50; Xerox $3.00. 44 pages.

CALCULATIONS OF COHERENT ATOMIC SCATTERING FACTORS FROM OPEN CONFIGURATION WAVE FUNCTIONS

(L. C. Card No. Mic 59-6733)

Robert Philip Hurst, Ph.D.
The University of Texas, 1958

Supervisor: F. A. Matsen

This dissertation discusses an investigation that was made to improve existing methods of calculating coherent atomic scattering factors. More specifically, open configuration wave functions, which permit some radial correlation, are used to determine factors for some two electron ions and for the lithium and beryllium atoms.

The scattering factors thus obtained are compared with corresponding closed configuration results and with factors obtained by previous workers.

It is found that the disparity between corresponding open- and closed-configuration factors decreases with increasing atomic number. In parallel trend it is shown that the improvement of open- over closed-configuration energies becomes less with increasing atomic number.

It is emphasized that the atomic scattering factor curve as calculated from atomic orbital product functions is a sensitive function of the orbital exponents. This is particularly true for the small values of $\sin \Theta/\lambda$. For some arguments the scattering factors are no more accurate than the choice of orbital exponent.

The open configuration factors for the lithium and beryllium atoms are in good agreement with recent Hartree-Fock results for most arguments. Since the open configuration energies are below the corresponding Hartree-Fock energies it seems probable that in the cases disparity is noted the open configuration factors are superior to the widely accepted Hartree-Fock factors.

Finally, it is pointed out that the open-configuration method is sufficiently general that it may be applied to other atoms with less labor than is required to make SCF type calculations.

Microfilm $2.50; Xerox $4.00. 74 pages.

VIBRATIONAL ANALYSIS OF 4,4-DIMETHYL-CYCLOPENTENE 4,4-DIMETHYLCYCLOPENTENE

(L. C. Card No. Mic 59-5143)

William H. Jones, Jr., Ph.D.
University of Delaware, 1959

Supervisor: Harold C. Beachell

The vibrational analysis of 4,4-dimethylcyclopentene has been carried out using a normal coordinate calculation based on the Wilson FG matrix technique. The model set up for calculation used a planar ring structure, a reasonable assumption for this molecule. In the calculation the methyl groups were considered as point masses. The model thus possesses C_{2v} symmetry. This allows its thirty-three fundamentals to be split up among four symmetry types according to

$$\Gamma = 11A_1 + 6A_2 + 9B_1 + 7B_2$$

The fundamental frequencies were calculated from the G_i and F_i ($i = A_1, A_2, B_1, B_2$) matrices using a matrix iteration program on an IBM-650 digital computer. The results of the calculation were consistent with the choice of model, as the calculated frequencies generally agreed with the observed infrared and Raman bands within ten percent. The infrared and Raman bands, not assigned as fundamentals, were interpreted as overtones and combinations of the fundamentals.

Microfilm $2.50; Xerox $6.00. 123 pages.

ALKALI METAL COPOLYMERIZATION OF ISOPRENE-STYRENE

(L. C. Card No. Mic 59-5191)

Donald J. Kelley, Ph.D.
Princeton University, 1958

Lithium, n-butyllithium (n-BuLi), and sodium were used to catalyze the polymerization of equimolar mixtures of isoprene and styrene in various solvents. The compositions of the copolymers initially formed were studied, since this illuminates the nature of the propagation step.

Under otherwise similar conditions, the copolymers produced by lithium and n-BuLi were identical. This is because the propagating species is the ion pair ($\text{polymer}^-\text{Li}^+$) in both cases.

In benzene or in undiluted monomers these catalysts gave copolymers containing somewhat less than 20 weight % styrene. In triethylamine, diethylether, and tetrahydrofuran (THF), the initial copolymers contained 60, 68, and 80% styrene, respectively.

Sodium dispersion produces copolymers of 66 weight % styrene in hydrocarbons and from 75 to 80% styrene in ionizing media.

It is deduced that the composition of the copolymers depends mainly on the ionic character of the ($\sim\sim C^-M^+$) ion pair. A nearly completely free anion gives a copolymer containing 80% styrene. Repressing the ionic character of the complex, by using Li^+ rather than Na^+ and by using non-ionizing solvents, lowers the styrene content. Other factors which might contribute to the observed effect are also discussed.

Monomer reactivity ratios were determined for Li, n-BuLi, and Na in benzene and in diethylether. The products (r_1r_2) indicate that a random copolymer results under conditions where the ($\sim\sim C^-M^+$) ion pair is least dissociated. Under ionizing conditions, low (r_1r_2) values indicate an alternating tendency. It is found that dissociation is also decreased when styrene (rather than isoprene) is the end unit on a growing chain and that isoprene monomer adds preferentially to a growing chain under non-ionizing conditions.

The structures of the isoprene residues were determined in the copolymers produced by the three catalysts in the various solvents. Lithium and n-BuLi yield approximately the same structures under otherwise similar conditions. Stereospecific homopolyisoprene with greater than 90% cis 1,4 is obtained in hydrocarbon solvents. Therefore it is surprising that these catalysts give isoprene residues of greater than 80% trans 1,4 in low conversion copolymer of about 20% styrene produced in benzene or in undiluted monomers. At higher conversions the percentage of cis 1,4 increases at the expense of trans 1,4.

In ionizing solvents, such as diethylether and THF, or when sodium is used as catalyst, more or less random mixtures of 3,4 and trans 1,4 are produced. In the highly polar THF a significant amount (5-10%) of 1,2 structure appears.

Styrene chain ends, hydrocarbon solvents, and Li^+ counterions all tend to lessen the degree of ionization and to cause isoprene monomer to add cis 1,4.

Microfilm $2.50; Xerox $3.80. 67 pages.

NUCLEATION IN THE PRECIPITATION OF SILVER CHLORIDE FROM HOMOGENEOUS SOLUTION

(L. C. Card No. Mic 59-5978)

David H. Klein, Ph.D.
Case Institute of Technology, 1959

The technique of precipitation from homogeneous solution has been employed to study the nucleation of silver chloride. Although critical supersaturations were observed, these were not critical concentrations in the sense suggested by the classical theory, but rather appeared to be functions of nucleation rate, crystal growth rate, and the sensitivity of the observing system. A kinetic method for determining the size of precipitation nuclei has been developed. This method, which is based on the relationship between the number of particles of precipitate formed and the time and concentrations during the nucleation period, indicates that the nucleus of silver chloride is small, consisting of about 8 to 10 ions, and thus supports the findings of the Christiansen-Nielsen theory of nucleation. The relationships between nucleation and precipitation from homogeneous solution have been studied. It has been found, by a proper choice of reactant concentrations, that the effect of nucleation on coprecipitation can be minimized, and also that the character of the precipitate obtained (i.e., the number of crystals and their size distribution) can be varied.

Microfilm $2.50; Xerox $3.00. 55 pages.

KINETIC STUDIES ON THE CATALYTIC HYDROLYSIS OF SALICYL PHOSPHATE AND ANALOGOUS COMPOUNDS

(L. C. Card No. Mic 59-6179)

Yukito Murakami, Ph.D.
Clark University, 1959

Supervisor: Arthur E. Martell

The purpose of this investigation is to obtain detailed information on the catalytic hydrolysis of salicyl phosphate and a number of its analogs.

The acid dissociation constants of two salicyl phosphate derivatives, 1,3-dicarboxyphenyl-2-phosphate (DCPP) and 1-methylcarboxy-3-carboxyphenyl-2-phosphate (MCPP), and of two isophthalic acid derivatives, 2-acetoxyisophthalic acid (AIPA) and 2-hydroxyisophthalic acid (HIPA), have been determined. The dissociation constants K_2, K_3, and K_4 at 35.0° of DCPP are 1.05×10^{-3}, 1.53×10^{-5}, and 4.47×10^{-9}, respectively. The acid dissociation constants, K_2 and K_3, at 35.0° for MCPP are found to be 4.17×10^{-4} and 2.45×10^{-8} respectively. Determination of the K_1 and K_2 of HIPA at 30.0° gave values of 7.40×10^{-3}, and 2.98×10^{-5}, respectively. AIPA has two dissociation constants, 1.4×10^{-3} and 1.6×10^{-4} for K_1 and K_2, respectively, at 25.0°.

The interactions of salicyl phosphate (SP) with copper(II) ion and the copper(II)-dipyridyl chelate were studied by means of potentiometric measurements at $10.1 \pm 0.05°$ and $\mu = 0.100$ M. The formation constant for the Cu(II)-SP chelate which is formed in slightly acidic solution was evaluated as $10^{3.64}$. It was found that Cu(II)-Dipy forms a chelate with SP, which has a formation constant of $10^{4.08}$. Chelate formation in slightly acidic solution is followed by the decomposition reaction to the triionic form of SP, Cu(OH)Dipy and $\{Cu(OH)Dipy\}_2$ in the region above $-\log [H^+] = 7.00$.

Hydrolysis rates of the organic phosphates, SP, MCPP, and DCPP, were measured by analysis of the amount of phosphoric acid produced during the course of reaction. First order (or pseudo-first order) kinetics were observed for most of the hydrolysis reactions in the present investigation.

Spontaneous hydrolysis reactions of DCPP and of MCPP reach their maximum rates at $-\log [H^+] = 3.90$ and 5.50, respectively. The rate constants for hydrolysis of the mono-, di-, and triionic species are $3.06 \times 10^{-5} sec^{-1}$, $2.26 \times 10^{-3} sec^{-1}$, and $1.05 \times 10^{-4} sec^{-1}$ for DCPP; $1.29 \times 10^{-5} sec^{-1}$, $2.69 \times 10^{-4} sec^{-1}$, and $2.24 \times 10^{-5} sec^{-1}$ for MCPP, respectively. To explain the unusually rapid hydrolysis rates of the diionic species, formation of the cyclic activated complex proposed by Chanley and coworkers (J. Am. Chem. Soc., 74, 4347 (1952)) was assumed.

Studies of the catalytic hydrolysis of SP at 30.0°, and of MCPP and DCPP at 35.0°, have been carried out at an ionic strength of 0.100 M. The Cu(II)-Dipy(1:1) chelate system was found to have a strong catalytic effect on the hydrolysis of DCPP in neutral and in alkaline solutions where neither the un-ionized nore the monoionic species are present. A semi-quantitative estimation of rate constants of the catalysts indicated that the monohydroxo chelate has catalytic activity at high pH, whereas the dihydroxo and the binuclear forms are relatively inert.

The catalytic effect of vanadyl ion on the hydrolysis of MCPP has been evaluated from the data obtained in the low pH region ($-\log [H^+] = 2.00$ and 3.00). The increased rate over that observed for spontaneous hydrolysis was ascribed to the catalytic effect of vanadyl ion on the hydrolysis of the diionic form of MCPP.

The Cu(II)-HEN(1:1) catalyzed hydrolysis of SP has been carried out in the middle pH range ($-\log [H^+] = 4.00$, 5.50, 6.00, 6.50 and 7.00). The increased hydrolysis rate was attributed to interaction of the diionic and the triionic species with Cu(II) ion.

Two possible reaction mechanisms which require the formation of a cyclic activated complex were proposed. One mechanism involves the coordination of the catalyst with the ester oxygen and the carboxylate oxygen. The other requires the coordination of the catalyst with the phosphate oxygens and the coordination of the carboxylate oxygen to the phosphorus atom to give a transition state similar to the one proposed by Chanley and co-workers for the spontaneous hydrolysis of salicyl phosphate.

Microfilm $2.50; Xerox $4.60. 88 pages.

THERMODYNAMIC PROPERTIES OF MOLTEN CHLORIDE SOLUTIONS

(L. C. Card No. Mic 59-3883)

Donald E. Neil, Ph.D.
Rensselaer Polytechnic Institute, 1959

Supervisor: Herbert M. Clark

The thermodynamic properties of molten chloride solutions were investigated by the use of the following galvanic cells:

$$Mg\text{-}Bi(\ell)\,|MgCl_2(N_1)KCl(N_2)(\ell)|graphite,\ Cl_2(g)$$

$$Mg\text{-}Bi(\ell)\,|MgCl_2(N_1)NaCl(N_2)(\ell)|graphite,\ Cl_2(g)$$

$$Mg\text{-}Bi(\ell)\,|MgCl_2(N_1)KCl\text{-}NaCl(\ell)|graphite,\ Cl_2(g)$$

$$Ce\text{-}Bi(\ell)\,|CeCl_3(N_1)KCl(N_2)(\ell)|graphite,\ Cl_2(g)\ .$$

The use of an alloy electrode in certain instances was demonstrated to have several advantages over the use of the pure metal. The factors which govern the selection of an appropriate alloy for use as an electrode are discussed.

A chlorine electrode was designed which proved to be easy to fabricate and which provided a steady potential with no evidence of hysteresis. The electrode should prove useful in other galvanic cells designed to study the thermodynamic properties of molten chloride solutions.

In the systems $MgCl_2$-KCl and $MgCl_2$-NaCl the quantities $F^E_{MgCl_2}$, $S^E_{MgCl_2}$, and $H^M_{MgCl_2}$ have been determined from the experimental galvanic cell measurements. The corresponding excess partial molar quantities for the second component were determined by numerical integration of the Gibbs Duhem equation. The integral molar quantities F^E, S^E, H^M, for the solution were calculated for both systems. Both systems exhibit a constant activity coefficient of magnesium chloride in solutions dilute in magnesium chloride. The value of this quantity was found to be

$$\gamma_{MgCl_2} = 4.5 \times 10^{-3}$$

in KCl solutions at 800°C; and

$$\gamma_{MgCl_2} = 3.7 \times 10^{-2}$$

in NaCl solutions at 825°C.

In the $MgCl_2$, KCl-NaCl system the ratio of moles of KCl to moles NaCl was constant in all solutions studied and was equal to 1.043. The thermodynamic functions $F^E_{MgCl_2}$, $S^E_{MgCl_2}$, and $H^M_{MgCl_2}$ were calculated from the galvanic cell data. In solutions dilute in magnesium chloride, the activity coefficient of this component was found to be constant and equal to

$$\gamma_{MgCl_2} = 8.1 \times 10^{-3}$$

at 800°C.

In the $CeCl_3$-KCl system the excess partial molar free energy of cerium chloride, $F^E_{CeCl_3}$, was determined. In solutions dilute in cerium chloride the activity coefficient was constant and equal to

$$\gamma_{CeCl_3} = 2.5 \times 10^{-4}$$

at 850°C.

The results obtained for the solutions containing $MgCl_2$ were interpreted by assuming the mixture was an ideal ionic solution of K^+ (or Na^+), Mg^{++}, Cl^-, and $MgCl_4^=$ ions. This assumption, together with the equations advanced by Temkin for such a solution, was used to calculate the relative partial molar free energy of magnesium chloride, $F^M_{MgCl_2}$, in the $MgCl_2$-KCl system at 800°C and the $MgCl_2$-NaCl system at 825°C. The experimental and calculated values of this function are shown to be in good agreement. The excess partial molar entropy of magnesium chloride in the two solutions exhibited a behavior which was shown to be consistent with the concept of the existence of complex ions in the melt.

The results of this research are discussed relative to the chemistry of the fuel reprocessing of a liquid metal fuel nuclear reactor.

Microfilm $4.30; Xerox $14.40. 333 pages.

QUANTUM MECHANICAL CALCULATIONS OF NUCLEAR MAGNETIC SHIELDING CONSTANTS

(L. C. Card No. Mic 59-6736)

Frederick Tuttle Ormand, Ph.D.
The University of Texas, 1958

Supervisor: F. A. Matsen

Atomic nuclear magnetic shielding constants were calculated for H^-, He, Li^+, Be^{++}, Li, Be^+, and Be using both open-configuration and closed-configuration wave functions with optimum orbital exponents and also using closed-configuration wave functions with orbital exponents given by the Slater rules. The close agreement between the present values obtained for He using optimum orbital exponents and the value calculated by Hylleraas and Skavlem using the first five terms of the Hylleraas wave function for He suggests that the present values obtained for the other atoms and ions using optimum orbital exponents may be considerably better than those previously reported, most of which were based on Hartree or Hartree-Fock SCF wave functions. Even the values computed using orbital exponents obtained from the Slater rules are in much closer agreement with those obtained using optimized orbital exponents than are the previous calculations (except for that of Hylleraas and Skavlem).

Nuclear magnetic shielding constants were also computed for the proton and the Li nucleus in the LiH molecule using a simple Lamb-type operator and the 6-term valence-bond wave function of Hurst, Miller, and Matsen. No attempt was made to include higher order correction terms in this calculation.

The auxiliary function $Eu_n(\delta,\gamma) = \int e^{-\delta\mu}\,\mu^n\,E_i^*(\gamma[1-\mu])\,d\mu$ was developed into a form suitable for machine computation and its application to the evaluation of integrals of the form $\int e^{-ar_a} r_a^m r_b^n \cos^q\theta_b\, e^{-br_b} d\tau$ for $a > 0$; $b > 0$; $m = -1, 0, 1, 2, \ldots$; $n = -1, -2, \ldots$; $q = 0, 1, 2, \ldots$; is illustrated. Formulas are listed for several commonly occurring integrals of this form in terms of $A_n(\alpha)$'s, $B_n(\beta)$'s and $Eu_n(\delta,\gamma)$'s; where $A_n(\alpha) = \int_1^\infty e^{-\alpha\lambda}\,\lambda^n d\lambda$, $B_n(\beta) = \int_{-1}^{+1} e^{-\beta\mu}\,\mu^n d\mu$.

Microfilm $2.50; Xerox $4.00. 71 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

THE CRYSTAL AND MOLECULAR STRUCTURE OF $B_{10}H_{12}(CNCH_3)_2$

(L. C. Card No. Mic 59-5087)

Josina van der Maas Reddy, Ph.D.
University of Minnesota, 1959

Adviser: William N. Lipscomb

An X-ray diffraction study of single crystals of $B_{10}H_{12}(CNCH_3)_2$ has yielded the positions of all atoms, including hydrogen atoms. The structure is regarded as a substitution derivative of the $B_{10}H_{14}^{-2}$ structure having C_{2V} symmetry, two bridge hydrogens and two BH_2 groups. A B—N single bond replaces a B—H of each BH_2 group and the acetonitrile residue is linear with normal bond distances, except for $C-CH_3$ = 1.45 Å in agreement with $C-CH_3$ = 1.46 Å in acetonitrile itself.

The unit cell is monoclinic, of symmetry I2/c, and has parameters a = 7.81, b = 11.31, c = 14.18 Å and $\beta = 96^{\circ}52'$. Final values of R = 0.15 and r = 0.12 were obtained.

Microfilm $2.50; Xerox $3.00. 43 pages.

THE VIBRATIONAL FREQUENCY DISTRIBUTIONS OF VITREOUS SILICA AND ALPHA-QUARTZ, CALCULATED BY THE FOURIER INVERSION OF THE HEAT CAPACITIES.

(L. C. Card No. Mic 59-5579)

John Moore Ruth, Ph.D.
The University of North Carolina, 1959

Supervisor: J. C. Morrow 3rd.

The Fourier inversion of the heat capacity, as treated theoretically by Montroll and by Taylor, was carried out to obtain the vibrational frequency distributions of vitreous silica and alpha-quartz, using C_v-values calculated by Lord and Morrow. If f*(t) is the function $\frac{C_v}{RT}$, g(θ) is the number of vibrational frequencies per unit of θ per molecule, and h*(t-s) is the function $\left(\frac{\theta}{2T}\right)^3 \frac{1}{\sinh^2\left(\frac{\theta}{2T}\right)}$, then

$$f^*(t) = 2\int_{-\infty}^{\infty} g(\theta)\, h^*(t-s)\, ds\,. \qquad (1)$$

Here, T is the absolute temperature, $\theta = \frac{h\nu}{k}$, t = ln T, s = ln θ, 2h*(t-s) represents the contribution of one harmonic oscillator to the function f*(t), and g(θ) is the frequency distribution. All vibrations are assumed to be harmonic. This integral representation of f*(t) is of the form of a Fourier resultant. The inversion theorem is known:

$$g(\theta) = \frac{1}{4\pi}\int_{\infty}^{\infty} \frac{F^*(u)}{H^*(u)}\, e^{-isu}\, du\,, \qquad (2)$$

in which F*(u) and H*(u) are the Fourier transforms of f*(t) and h*(t), respectively, absolute integrability of g(θ) and h*(t) being required.

In the present work, the function H*(u) was put into series form, and the real and imaginary parts were computed to five figures for values of u between 0 and 10, at intervals of 0.1 in u. The transform F*(u) was computed by numerical integration, and the transform of the quotient of the first two transforms was then computed by numerical integration, to give g(θ). Equation (2) becomes

$$g(\theta) = \frac{1}{2\pi}\int_0^{\infty} [K_1^*(u)\cos su + K_2^*(u)\sin su]\, du,$$

where $K_1^*(u)$ and $K_2^*(u)$ are the real and imaginary parts, respectively, of the quotient of the first two transforms. In the numerical approximation, the upper limit ∞ must be replaced by a finite limit u_L, whose choosing must be done carefully.

The F*- and H*-functions are made up of waves of decreasing amplitude. In the quotient, the K*-functions are also composed of waves, whose amplitude at first decreases and then increases again. With given approximations to the F*- and H*-functions, the problem becomes a choice of the best value of u_L. Different values were tried and tests were applied to the resulting frequency distributions. Test I was the use of equation (1) to obtain a function f*(t), which was then compared with the original f*(t) used in computation. Test II was the application of the equation

$$\int_0^{\infty} g(\theta)\, d\theta = 3n\,,$$

where n is the number of atoms in the molecule or the formula unit.

After various values of u_L between 2 and 10 had been tested, the value 3.0 was chosen for each of the present approximations. The frequency distributions obtained each have a single peak. As g(θ) decreases toward 0 for $\theta \to 0$ and for $\theta \to \infty$, g(θ) is eventually obscured by an oscillating error. For u_L equal to 3.0, the original f*(t) is reproduced in Test I with an error not greater than about 1% of the maximum value of that function, which of course obscures it as $f^*(t) \to 0$ at the ends of the scale.

The peak in g(θ) for alpha-quartz is higher and narrower than that for vitreous silica, which is flattened at the top. The peak for alpha-quartz and the front (low frequency side) of the peak for vitreous silica are near the corresponding Debye θ-values.

The error causing the eventual divergence of the K*-functions, as u becomes larger, was investigated. Examination of that obtained by approximation of f*(t) with polynomials in T ($=e^t$) showed that, even without the numerical error of an approximation, the analytic form of such an approximation will eventually produce the same kind of behavior.

Microfilm $2.60; Xerox $9.00. 198 pages.

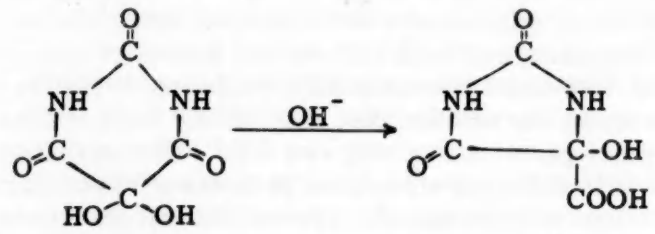
THE KINETICS OF THE BASE-CATALYZED ALLOXANIC ACID REARRANGEMENT

(L. C. Card No. Mic 59-5148)

Ilya Mark Sarasohn, Ph.D.
University of Delaware, 1959

Supervisor: Harold Kwart

The kinetics of the base-catalyzed conversion of alloxan to alloxanic acid has been studied in aqueous solution:



Alloxan Monohydrate Alloxanic Acid

The reaction was found to be first-order in substrate and exhibited a complex dependency on hydroxide ion:

$$k_{obs} = \frac{k_1K_1[OH] + k_2K_1K_2[OH]^2 + k_3K_1K_2K_3[OH]^3}{1 + K_1[OH] + K_1K_2[OH]^2 + K_1K_2K_3[OH]^3}$$

where K_1, K_2, and K_3 are the apparent equilibrium constants for hydroxide ion with alloxan monohydrate and its variously charged conjugate bases: AH_3^-, $AH_2^=$, and $AH^{\equiv}$. The specific rate constants for the rate-determining rearrangement of these charged anions are k_1, k_2, and k_3, respectively. The relative magnitude of these rate constants indicates that rearrangement is facilitated by the generation of a region of high negative charge density in the vicinity of the migrating bond.

Phosphate ion catalysis has been observed in the pH region where the trianion of alloxan monohydrate is formed. This is interpreted as general base catalysis and indicates that the process may involve a rate-determining proton transfer at this stage.

Borate ion catalysis of the monoanion of alloxan monohydrate has been demonstrated and several transition state intermediates have been proposed to account for this phenomenon, an example of specific base catalysis.

The kinetics of the reaction between hydroxide ion and diphenyl triketone monohydrate has also been investigated. This system exhibits first-order dependency in substrate and in hydroxide ion. Borate ion catalysis was also observed. A mechanism analogous to that proposed for the alloxanic acid rearrangement is suggested.

Microfilm $2.50; Xerox $8.40. 181 pages.

STUDIES ON SOME MOLECULAR AND NUCLEAR PROBLEMS. PART I: THE C≡N STRETCHING FREQUENCY AND MOLECULAR STRUCTURE. PART II: MECHANISM FOR THE CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS.

(L. C. Card No. Mic 59-3477)

Mostafa Fahmi Amr El Sayed, Ph.D.
Florida State University, 1959

The first part consists of two sections. In the first one, group theoretical methods are used in order to calculate the number of the C≡N stretching infrared active vibrations for the energetically favorable structures that can be formulated according to the Theory of Directed Valence for $[Ni(CN)_4]^{-2}$, $[Ni_2(CN)_6]^{-4}$ and $[Ni(CN)_4]^{-4}$. The infrared spectra of these complexes is given in the NaCl region. The presence of one absorption band at 2135 cm^{-1} for $[Ni(CN)_4]^{-2}$ agrees with a square planar structure. The spectrum of $[Ni_2(CN)_6]^{-4}$ shows only three infrared bands in the C≡region at 2128, 2079 and 2055 cm^{-1}. This excludes the structure bridged through C=N groups which is proposed as a result of a preliminary incomplete X-ray analysis. Instead, a structure bridged through C≡N groups, using three center molecular orbitals, is considered. This structure, however, is found to be energetically unfavorable in comparison with the structures that can be formed from two square planes connected through a point. These last structures are also found to agree satisfactorily with the infrared results. The presence of only one infrared band at 1985 cm^{-1} for $[Ni(CN)_4]^{-4}$ agrees with the analysis for a tetrahedral structure. The low value of the C≡N stretching frequency of this complex compared with that of $[Ni(CN)_4]^{-2}$ is explained in terms of the Pauling's Principle of Electrical Neutrality.

In the second section, the position of the C≡N stretching frequency in organic and inorganic molecules is discussed in terms of the contribution of the ionic resonance forms. Generally, it is found that as this contribution increases, the C≡N stretching frequency decreases. In organic nitriles, the contribution of these forms is discussed in terms of the inductive and the mesomeric effects of the attached groups. In inorganic cyanides this contribution is discussed in terms of the electronegativity, and the oxidation and coordination numbers of the central atom.

In the second part, the interaction of high energy tritium (H^3), formed by nuclear recoil, with gaseous methane and ethane, has been investigated under a wide variety of conditions. In the case of methane, a number of labeled products, chiefly HT and CH_3T, together with smaller amounts of higher tritium labeled hydrocarbons are formed. If a radical scavenger, such as I_2, is present, the yield of CH_3T is little changed, but the amount of HT is halved and the higher hydrocarbons eliminated. These results are not consistent with present theories of the mechanism of the primary step of hot atom reaction. A mechanism involving a high energy one-step displacement reaction as the primary reaction of the hot atom is suggested. Some of the labeled products of this primary reaction reach thermal energies as radicals which will then undergo further secondary reaction. Unlike the primary hot reactions, these thermal secondary processes are sensitive to the addition of radical scavengers. Evidence for this mechanism is obtained from a consideration of the

detailed product distributions and their changes when certain experimental conditions, such as radiation intensity are varied. Particularly significant are the consequences of the addition of a large excess of He^4 to moderate the hot atoms. A review of earlier data makes it appear probable that the primary hot replacement mechanism thus indicated for the gas phase reaction of recoil tritium is also operative in the condensed phase. The further extension of this mechanism to hot atom reactions in general is briefly discussed.

Microfilm $2.50; Xerox $7.40. 159 pages.

THERMODYNAMICS OF ELECTROLYTES IN MIXED AQUEOUS SOLUTIONS

(L. C. Card No. Mic 59-5533)

Linda Lou Smith, Ph.D.
University of South Carolina, 1959

Part I. The Effect of Temperature on Ion-Exchange Equilibria. The Sodium-Hydrogen Exchange.

Ion-exchange reactions between sodium and hydrogen on sulfonated polystyrene type (Dowex 50) resins have been studied over the temperature range 0 to 97.5° C. The equilibrium constant K_H^{Na} is greater than unity over this entire temperature range and decreases with increasing temperature. ΔH^0 and ΔS^0 for the exchange reaction are both negative over the range of temperatures studied. The effect of temperature decreases with decreasing divinyl benzene content of the resin. The variation of the equilibrium constants with temperature is believed to be caused primarily by the change of activity coefficients of the ions in the resin phase.

Part II. The Determination of Activity Coefficients of Hydrochloric Acid and Para Toluene Sulfonic Acid in Binary Aqueous Solutions from Electromotive Force Measurements.

Activity coefficients of each acid have been determined in mixtures of hydrochloric acid and para toluene sulfonic acid (p-TSA) up to concentrations of 6 molal by electromotive force measurements of the cell,

$$Pt, H_2/HCl\ (m_1)\ p\text{-}TSA\ (m_2)/AgCl\ (s), Ag.$$

The mole ratios of hydrochloric acid to para toluene sulfonic acid ranged from 4.95 to 0.27. The results show that the activity coefficient of HCl at constant total molality in the mixtures is decreased by the addition of para toluene sulfonic acid; the activity coefficient of the para toluene sulfonic acid, on the other hand, is increased by the addition of hydrochloric acid while maintaining the total molality constant. Harned's rule holds for the hydrochloric acid up to a total molality of 2.0; but for the sulfonic acid, deviations from Harned's rule become quite marked above a total molality of 0.4.

Microfilm $2.50; Xerox $4.60. 86 pages.

CORRELATION OF OSMOTIC PROPERTIES OF MEMBRANES WITH STRUCTURE

(L. C. Card No. Mic 59-6111)

Harold Garth Spencer, Ph.D.
The University of Florida, 1959

Several polymeric membranes were investigated for the purpose of determining their ability to filter ions from saline solutions forced through them by direct hydrostatic pressure. The ohmic resistance of the membranes was also determined to provide a means of classifying them as ion-excluding or ion-selective. Ion-excluding membranes block the passage of both cations and anions of the salt solution with about equal facility, while ion-selective membranes filter the salt because they have a high resistance to the passage of ions of only one sign. The use of membranes with different structural features permits some correlation between osmotic properties and structure.

The three membranes used in this investigation which function as ion-excluding membranes are cellulose isobutyrate, cellophane-supported polyvinyl acetate, and cellophane-supported polyvinyl methyl ketone. The salt rejection of the last two is apparently a property of the interfacial region between the polymer film and the cellophane. The osmotic and ohmic resistance properties of these membranes are consistent with a theory advanced by Reid and Breton, which explained the function of ion-excluding membranes in terms of a network of bound water within their pores.

Ion-selective membranes capable of moderately high salt rejection can be prepared by cross-linking a mixture of polyvinyl alcohol with a small fraction of a 1-1 copolymer of methyl vinyl ether and maleic anhydride. The salt rejection apparently depends on the restriction of the interchain distances and the concentration of the polyanhydride. Extensive cross-linking produces brittle membranes; however, composite membranes composed of a thin film of the mixture cast on cellophane are strong and flexible. Composite membranes containing large fractions of the polyanhydride have high salt rejection.

The salt rejection by both types of membranes is inversely related to the flow rate, and it apparently depends on a high concentration of the required functional groups and on the restriction of the interchain distances.

Microfilm $2.50; Xerox $3.00. 50 pages.

STABILITY OF α, β, γ, δ-TETRAPHENYLPORPHINES TOWARD IRRADIATIONS

(L. C. Card No. Mic 59-4666)

Anton Szutka, Ph.D.
University of Pennsylvania, 1959

Supervisors: J. Fred Hazel and Wallace M. McNabb

The fate of the porphine ring upon interaction with high energy radiations has not yet been fully elucidated. α, β, γ, δ-tetraphenylporphine has been used as a model system.

α, β, γ, δ-tetraphenylporphine dissolved in phosphoric acid, sulfuric acid, formic acid, acetic acid or propionic acid was irradiated with X-rays, γ-rays or α-particles.

The changes occurring on irradiation of α, β, γ, δ-tetraphenylporphine in sirupy phosphoric acid, concentrated sulfuric acid and 49 per cent sulfuric acid were followed spectrophotometrically and were found to correspond to one and two electron oxidation states of tetraphenylporphine. The spectra were proven to be qualitatively identical with those produced by the Fenton reagent and ceric ions. The spectrophotometric titrations with ceric ions showed one and two electron oxidations to be involved. The regeneration of the spectrum of free tetraphenylporphine from the spectrum of oxidized products with the time suggested that a disproportionation of the oxidized product to the free tetraphenylporphine and some higher oxidation states takes place. A linear relationship was found between irradiation dose and the decrease in optical density of the Soret band up to about 1000 r in sirupy phosphoric acid and up to about 2000 r in concentrated sulfuric acid and 49 per cent sulfuric acid. A 50 per cent decrease in the Soret band was produced in phosphoric acid upon irradiation with approximately 620 r as compared with approximately 1150 r for concentrated sulfuric acid and 49 per cent sulfuric acid.

In contrast to the behaviour in sirupy phosphoric acid and sulfuric acid, no significant changes were noted on irradiation of α, β, γ, δ-tetraphenylporphines on organic acids with low dosages, up to 5000 r. Higher dosages, from 100000 r up, produce a decrease in the optical density of the Soret band and of the band in the red region. The stability of tetraphenylporphine in organic acids decreases with the increase of the number of carbon atoms of the acid.

A mechanism involving one and/or two electron oxidation followed by disproportionation is suggested. Hydroxyl and perhydroxyl radicals as well as hydrogen peroxide and peracids seem to be responsible for the oxidation. The rate of disproportionation of oxidation products has been found much higher in organic acids than in phosphoric acid or sulfuric acid media.

Gamma-irradiation of a mixture of benzaldehyde and pyrrole in pyridine resulted in formation of porphine-like substances among other products. The porphine formed was identified as α, β, γ, δ-tetraphenylporphine by visible spectra of the free base, visible spectra of the acid salt and visible spectra of the zinc complex. All spectra were found to be identical with those obtained with the reference compound. The results imply that the formation of complicated organic molecules from simple precursors is possible under the influence of radiation from terrestrial sources. It also may throw some light upon the origin of so called "organic milieu," the nonliving mixture of carbon compounds, which is generally considered as a prerequisite of the origin of life. The availability of precursors as well as energy necessary for the reactions to occur in the primaeval earth conditions is discussed.

Microfilm $2.50; Xerox $5.60. 115 pages.

ELECTROSTATIC EFFECTS IN THE ADHESION OF POLYESTER RESIN TO GLASS

(L. C. Card No. Mic 59-5990)

Nicholas Michael Trivisonno, Ph.D.
Case Institute of Technology, 1958

It has been found in the past that when an adhesive bond is broken, a separation of electrical charge occurs, indicating that charge had been transferred across the adhesive interface at some time during or after formation of the adhesive bond. This separation of charge results in an electrostatic force of attraction between the adhering substances. During the course of this work, the charge separation occurring when an unsaturated polyester resin – styrene adhesive was broken from a glass surface was studied experimentally to determine the magnitude of charge separated, and the contribution of the electrostatic forces involved to the total force of adhesion.

Discharge limited charge separations of greater than 300 esu/cm^2 were measured by integration of a voltage versus time oscilloscope trace. Calculations were made based on a mathematical analysis of the transient voltage effects occurring in the first few microseconds following break to minimize discharge and field emission effects. Charge separations of greater than 10^3 esu/cm^2 were so calculated. Electrostatic forces resulting from charge separations of this magnitude are sufficient to account for the major portion of the total force of adhesion in the system studied. Microfilm $2.75; Xerox $9.40. 209 pages.

POLAROGRAPHIC STUDY OF HYDROPEROXIDES AND HYDROGEN PEROXIDE IN HYDROCARBON COMBUSTION PRODUCTS

(L. C. Card No. Mic 59-6653)

Paul Urone, Ph.D.
The Ohio State University, 1954

The study of hydrocarbon combustion products is but one of many studies being undertaken in order to understand more completely the mechanisms of fuel combustion. The polarographic technique is but one of the analytical methods available for the analysis of these products. Nevertheless, the polarograph has its own peculiar attributes which can contribute to the solution of problems arising in the analysis of the products of combustion. It can measure quantitatively and semi-qualitatively the currents used in the electro-reduction of the products of oxidation or combustion. Among these products are to be found hydrogen peroxide, formaldehyde, higher aldehydes, and organic hydroperoxides.

The present study has been concerned with the polarographic behavior of organic hydroperoxides. It has been shown that these substances can be reduced at the dropping mercury electrode. An aqueous electrolytic solution was preferred to an organic electrolytic solution for the polarographic analysis of these compounds. This was done because better current-voltage curves are obtained, and there is a better separation of the various waves.

The halfwave potentials of the hydroperoxides studied

ranged from 0.00 to -0.24 volt vs. the saturated calomel electrode (Table I). They are but little affected by hydrogen ion concentration in the pH range of 7 to 10; on the other hand benzene and dioxane tend to increase the halfwave potentials of the organic hydroperoxides until they approach the halfwave potential of hydrogen peroxide. Methyl alcohol does not have much effect in concentrations up to 15 per cent. Those substances which are not easily soluble in water may, therefore, be dissolved in methyl alcohol before being added to the solution to be analyzed polarographically. A solution buffered at a pH of 7.00 or a neutral 0.1 N potassium chloride solution may be used with satisfactory results in the polarographic analysis of these compounds.

Table I. Summary of Halfwave Potentials and Diffusion Current Constants

Hydroperoxide	Halfwave Potential (Negative Volts vs. S.C.E.)	$\frac{i_d}{C m^{2/3} t^{1/6}}$
tert-Butyl	0.23 ± 0.03	4.1
2-Butyl	0.24	2.7
3-Methylbutyl	0.16	3.0
3-Pentyl	0.14	4.3
Cyclopentyl	0.16	3.7
Cyclohexyl	0.10	3.6
3-Cyclohexenyl	0.10	4.3
4-Octyl	0.03	1.6
2,5,5-Trimethyl-2-hexyl	0.12	3.4
2,4,4-Trimethyl-2-pentyl	0.17	2.9
Ethycyclohexyl-1	0.05	4.2
Benzyl	0.05	---
α-Phenylethyl	0.00	4.6
alpha-p-Methyl-phenylethyl	0.00	3.6

A total of fifteen hydroperoxides, two peroxides, and one peracid were studied. The halfwave potentials and diffusion current constants of each were found (Table I). On the whole, the halfwave potentials increased with the apparent compound stability, but decreased in the presence of phenyl groups.

A method of quantitatively separating hydrogen peroxide from the organic hydroperoxides has also been developed. In this case the polarographic solution is 0.1 N in potassium chloride plus one drop of phenol red (0.1 per cent) and just enough ammonium hydroxide to bring the solution to the phenol red end point at a pH of approximately 8. After a polarogram has been run, the hydrogen peroxide wave may be eliminated by precipitating the hydrogen peroxide as the perhydrate of titanium, zirconium, or thorium. Organic hydroperoxides are not precipitated with the hydrogen peroxide, and the method seems to be almost specific for hydrogen peroxide. Carbonate, borate, urea, and aluminum ions, although forming per-compounds were ineffective in separating hydrogen peroxide under the conditions used.

The hydrogen peroxide may be quantitatively recovered by either filtration or centrifugation of the precipitate. The precipitate may be then dissolved in ten per cent sulfuric acid and titrated with standardized potassium permanganate for quantitative measurements. For best results the concentration of the hydrogen peroxide should not exceed 0.6 milligrams per milliliter (0.02 molar), and the precipitating agent should be in at least threefold molar excess. Solutions of hydrogen peroxide and organic hydroperoxide with mole ratios as high as 200 to 1 have been quantitatively separated and recovered.

The method has had practical applications in cool flame and reaction vessel oxidation studies. In the cool flame studies, samples of the air-fuel mixtures were withdrawn at different positions in the cool flame tube and passed through bubblers containing 0.1 N potassium chloride. After proper pH adjustments, the solutions were analyzed polarographically to show the amounts of hydroperoxides, hydrogen peroxides, and various aldehydes as they appeared or disappeared along the length of the heated tube. Three liters of gaseous mixtures furnished a sufficiently large sample.

In the reaction vessel studies, the fuel-gas mixtures were passed through similar scrubbing solutions after having been heated under controlled time and temperature conditions. Samples as small as 250 milliliters of the gaseous mixtures were analyzed.

Microfilm $2.50; Xerox $4.40. 83 pages.

Abstract published by special arrangement with The Ohio State University.

VOLTAMMETRY AT CONTROLLED CURRENT. THE ANODIC OXIDATION OF SOME ORGANIC COMPOUNDS AT SOLID ELECTRODES.

(L. C. Card No. Mic 59-5237)

John Davidson Voorhies, Ph.D.
Princeton University, 1958

Two methods of voltammetry at controlled current have been investigated with regard to the anodic oxidation of some organic compounds at solid electrodes. Results having electrochemical and electroanalytical significance were obtained.

A method of automatic recording current-scanning polarography was developed and tested on some classical inorganic redox systems. This technique was then employed in an anodic study of the chemotherapeutically active sulfonamides known as the sulfa drugs at a rotating platinum electrode. The most significant result of this study was the interpretation of the plots of pH versus the $E_{\frac{1}{2}}$ of anodic polarograms. According to the polarographic theory of electrode processes involving hydrogen ions, the intersections of linear portions of the $E_{\frac{1}{2}}$ vs. pH curves for such electrode processes occur at the pK_a's of the compound being electrolyzed. Thus, the pK_a values for the several acid-base functions in the sulfonamide molecule can be determined polarographically. pK_a data for several sulfas including sulfanilamide, sulfadiazine, sulfapyridine, sulfathiazole, sulfadimetine and n-butyl carbamyl sulfanilamide (Orinase or BZ-55) are reported. These data are in good agreement with values reported in the literature for some of the compounds studied. A mechanism for the anodic oxidation of the primary aromatic amino group in the sulfonamides is also proposed.

The quantitative analytical potentialities of the current-scanning technique were only briefly studied. The variation of limiting current with concentration of electroactive material for the anodic oxidation of iodide and some of the sulfas was checked, but no data of high precision were obtained.

Voltammetry at constant current or chronopotentiometry was found to be a rapid and effective method for the quantitative determination of organic compounds having an oxidizable functional group. The constant-current technique was applied to compounds in the following functional group categories: aromatic amines, aliphatic sulfides, sulfhydryl compounds, phenols and aromatic hydrocarbons containing "oxidizable pi electrons."

Many experiments were performed to evaluate chronopotentiometric precision under various experimental conditions. The best precision (ca. $\pm$ 0.5% - σ) in the measurement of concentration was obtained by an oscillographic technique for measuring very short chronopotentiometric "transition times." However, an average standard deviation precision of $\pm$ 1% was obtained by means of a conventional recording potentiometer for measuring long transition times (> 5 sec.).

The variation of $T^{\frac{1}{2}}$ (T is the transition time), the quantity which is directly proportional to the concentration of electroactive material for linear diffusion-controlled electrode processes, as a function of concentration, solution temperature and current density was thoroughly investigated for several compounds. $T^{\frac{1}{2}}$ versus concentration plots were used as calibration curves in the analysis of crude solutions of 2-mercaptobenzothiazole. Most of these studies were done on aqueous solutions, but acetonitrile and methanol were frequently used as solvents.

In addition to the quantitative analytical results, a great deal of information regarding electrode surface phenomena and peculiar organic electrode processes was obtained by the method of chronopotentiometry. Although this information is not sufficient to permit the complete evaluation of electrode surface phenomena, some instructive conclusions regarding these phenomena can be stated. Particular consideration was given to the effect of surface oxidation of the gold and platinum electrodes on potential-time curves.

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With regard to the analytical utility of solid electrode voltammetry at controlled current, it seems that chronopotentiometry has more to offer than the current-scanning technique. Chronopotentiometry is faster, more precise and more amenable to instrumentation than the scanning technique. However, current-scanning polarography has the advantage of greater sensitivity for organic compounds. Considering the similarity in the components of the chronopotentiometric and current-scanning apparatus, a combined current-scanner - constant current - recorder system would have considerable potentialities as an electroanalytical tool. Microfilm $2.90; Xerox $10.00. 222 pages.

KINETICS OF THREE-STEP CONSECUTIVE-COMPETITIVE SECOND-ORDER REACTIONS. KINETICS OF THE ALKALINE HYDROLYSIS OF 1,3,5,-TRI(4-CARBOMETHOXY-PHENYL)-BENZENE.

(L. C. Card No. Mic 59-3026)

Harold Edward Weisberg, Ph.D.
University of Maryland, 1958

Supervisor: William S. Sverbely

The three-step alkaline hydrolysis of 1,3,5-tri(4-carbomethoxyphenyl) benzene has been studied in dioxane-water mixtures at three temperatures. The three rate constants have been determined at each temperature, and isocomposition and isodielectric activation energies have been calculated. The frequency factors, A, and the thermodynamic functions of activation, $\Delta S^{\ddagger}$ and $\Delta F^{\ddagger}$, have been computed.

Sodium hydroxide was the base used in the reaction. The rate was followed by titrimetric determination of remaining hydroxyl ion in samples removed at measured time intervals.

Due to restrictions imposed by the limited solubility of the triester in solutions of low dioxane content, and the limited solubility of sodium hydroxide in solutions of low water content, only a single isocomposition medium was employed, (82% by wt. dioxane), and only a single isodielectric medium (D = 9.07). Although the initial concentration in most cases was approximately 0.01N, measurements were also made with initial concentration at approximately 0.005 N to ascertain general conformance of the reaction to the proposed rate law.

The rate constants were found, within experimental error, to be in the ratio $k_1:k_2:k_3 = 3:2:1$, indicating that no factors other than statistical ones were influencing the ratio. Due to the necessity of working at so low a dielectric constant, it was not possible to study the effect of ionic strength on the rates. It appears, moreover, since the simple statistical ratios among the rates is borne out, that no cumulative ionic strength effects have been observable. The data are interpreted as showing that each step in the hydrolysis is a molecule-ion reaction and is independent of the condition of the other two reaction sites.

Over the temperature range studied, 34.98^{0}-56.12^{0} C, the activation energies were found to be constant within experimental error. It was possible to separate the isocomposition and isodielectric activation energy curves.

Statistical analyses of both experimental and calculated data have been made.

Microfilm $2.50; Xerox $4.80. 91 pages.

ECONOMICS, GENERAL

FACTORS AFFECTING THE OPTIMUM LOCATION AND LAYOUT OF PLANNED SUBURBAN BUSINESS DISTRICTS

(L. C. Card No. Mic 59-5347)

Gordon Gouverneur Barnewall, Ph.D.
The Ohio State University, 1953

Although suburban business districts in one form or another have existed for many centures, they have assumed, since 1945, a new significance in the marketing structure. During this time, suburban business operations, part of the general decentralization movement in the urban areas of the United States, have greatly expanded. It has been characteristic of this expansion that relatively little systematic planning or research has been employed by promoters or suburban merchants. As a result, the pattern of suburban retailing has emerged in a somewhat haphazard form. Failures in suburban business districts have not been uncommon. It is felt that a large proportion of these failures has been caused by the lack of systematic planning of the location, form, and layout of suburban business districts.

The dissertation is concerned only with the planned suburban business districts, that is, those which were planned and promoted as a unit. These districts, it is felt, enjoy an initial advantage over the older "unplanned" districts, which are simply geographic groupings of individual suburban business enterprises. Furthermore, it is felt that the future development of suburban business districts will consist almost entirely of planned centers because (1) most new suburban residential districts are planned as units, and (2) merchants must reduce the rate of suburban business failures.

OBJECTIVES OF THIS STUDY

Through library research and through conferences with marketing teachers, officials in the United States Department of Commerce, and interested business men, it was determined that many of the gaps in the existing knowledge about shopping centers could be bridged by a research project planned to fulfill the following objectives:

1. The development of a method of studying scientifically the retail trade structure of metropolitan areas and the testing of the applicability of such a method in one selected metrpolitan area (Washington, D. C.)
2. The ascertainment through application of the research method developed, of the actual characteristics of the retail trade structure of the selected area with respect to relative importance of the downtown shopping area and suburban business districts, and the types, characteristics, and trading areas of the suburban business districts
3. The development of criteria useful in locating shopping centers and the testing empirically of the validity of such criteria with reference to varying degrees of successful sales volume experienced by suburban business districts in the Washington, D. C., area.
4. The formulation of sound rules of action that may be observed in the internal planning of new shopping centers with respect to their composition in terms of number and kinds of stores, location of individual unit, parking space, auxiliary services, and so on.

The organization of this study is along the lines of the four objectives stated above.

METHODS AND SOURCES OF INFORMATION

In order to develop a method for planning a suburban business district location and layout, it was first necessary to determine the factors affecting location and layout success. A preliminary statement of these factors was developed from the work of other students of suburban business problems and from general principles of marketing. Some of these factors are, of course, prima facie determinants of success, but it is not enough simply to state the factors, or causes, of success or failure. It is necessary to assess the amount of influence each exerts and to measure it whenever possible.

To test the hypothetical factors affecting location and layout, case studies were made of 42 individual suburban business districts in the Metropolitan Washington area. All districts for which 1948 Census of Business data were available were included. It was felt that a comprehensive study of a single metropolitan area was the best method of studying suburban business districts on a comparative basis. The geographic proximity of the centers studied permitted the elimination of the effects of extreme differences resulting from variations among different metropolitan areas.

Each individual center was visited and mapped by means of personal observation and the use of Sanborn scale maps [1] General characteristics of each center, such as geographic features and traffic patterns, were also determined by personal observation. An approximate trading area was established for each center on the basis of a survey of an adequate sample of the center's patrons. An interviewer asked patrons of the center for their addresses and these were plotted on a map. Trading areas for each center were determined from addresses so reported, and approximate trading area boundaries were plotted on a large map of the metropolitan area.

Census data were then obtained showing sales, employees, and pay rolls for each type of business group in (1) the center itself, and (2) the Business Enumerator Districts which most nearly approximated the trading area. Basic information necessary to evaluate the degree of success or failure of each business district was secured in this manner.

Secondary sources used in the study include local planning commissions, chambers of commerce, the National Capital Park and Planning Commission, and the Washington Board of Trade.

Application of the method to an individual potential site is illustrated in the dissertation in Appendix T by one detailed research project, the Eastman Study, which involved the complete planning of the location and layout of a suburban business center.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

SUMMARY AND CONCLUSIONS

The conclusions drawn from this research project may be summarized in two major categories, namely, those which are of general social and economic interest and those which are chiefly concerned with improvements in specific types of planning practices as carried on by merchants and developers of shopping centers.

Magnitude of suburban business districts.—Several statements can be made with regard to the importance of various types of centers. It seems that the late 1940's was the high point of the growth and volume of business done in unplanned centers. Competition among centers has forced builders to plan carefully and develop complete units instead of merely building wherever there was a vacant lot.

In 1948, suburban business districts in Metropolitan Washington accounted for between eight and 10 per cent of all retail store and service sales. Unplanned centers accounted for approximately 64 per cent of the total volume of $126,500,000 for all suburban business districts (see Table I). About 22 per cent of the suburban business district volume was done in planned centers; partially planned centers accounted for the remainder.

Table I

Total Stores, Sales, Employees, and Pay Rolls of All Stores in the Suburban Business Districts of Metropolitan Washington, by Degree of Planning: 1948

Degree of Planning	Stores (Number)	Sales Entire Year (000)	Pay Roll Entire Year (000)	Paid Employees Work Week Ended Nearest Nov. 15th
Planned districts	211	$27,638	$2,927	1,599
Semiplanned districts	102	16,859	1,687	864
Unplanned districts	578	82,012	9,806	5,021
Total	891	$126,509	$14,420	7,404

Source: Special tabulations of census schedules by the Business Division of the Bureau of the Census, U.S. Department of Commerce, as reproduced from Table 5 in the dissertation.

Of the 891 stores found in all suburban business districts, 136 were in neighborhood centers which had a total volume of $14,556,000, or 11 per cent of the suburban business district total (Table II). Shopping centers, with 338 stores, accounted for 35 per cent of this volume, and the 417 stores in regional centers accounted for 54 per cent.

Neighborhood centers averaged eight to 10 stores per center; the typical shopping center consisted of about eighteen to twenty stores; and regional centers averaged about seventy stores per center.

Future of suburban business districts.—The general future of suburban business districts in the Metropolitan Washington area is a bright one. Major growth, with less emphasis on shopping centers and far less on regional centers, is likely to develop in planned neighborhood centers. This is accounted for by the fact that (1) in most areas large regional centers have already been built and in most cases they still have a capacity far greater than the present volume of business, and (2) regional centers require a large trading area, from ten to fifty square miles, and there are not many areas of this size which are not already being served by an existing center. However, people are moving in increasingly large numbers to small planned single home developments or apartment projects. Adjacent to these new developments and next to unserved existing ones is a ready-made market for new planned neighborhood centers.

Table II

Total Stores, Sales, Employees, and Pay Rolls of Stores in the Suburban Business Districts of Metropolitan Washington, by Type of Center: 1948

Type of District	Stores (Number)	Sales Entire Year (000)	Pay Roll Entire Year (000)	Paid Employees Work Week Ended Nearest Nov. 15th
Neighborhood	136	$14,556	$1,404	800
Shopping	338	44,686	4,588	2,403
Regional	417	67,266	8,428	4,281
Total	891	$126,508	$14,420	7,484

Source: Special tabulations of census schedules by the Business Division of the Bureau of the Census, U.S. Department of Commerce, as reproduced from Table 6 in the dissertation.

In line with population growth in their trading areas, future development is also likely to come from expansion of existing neighborhood centers. Such centers will include several shopping goods outlets and an expansion of the parking facilities, thus changing the existing center into a shopping center.

It is believed that existing regional centers will be expanded to meet increased markets. Development of numerous completely new centers, however, is not probable.

According to the data in Table II, suburban shopping districts in 1948 accounted for $126,508,000 sales and service receipts. It is estimated that in 1952 such districts accounted for $213,000,000 sales and service receipts out of a total of $1,800,000,000 estimated for Metropolitan Washington. Thus it appears that suburban business districts have advanced from a position of eight to nine per cent of the total retail sales in 1948 to a position of eleven to twelve per cent in 1952. It seems unlikely that their sales will ever move beyond twenty per cent of the total market and will most likely take fifteen to twenty years to gain such a maximum position. Probably the area of their largest gains will be in taking business away from the now existing string street arrangements and secondary business districts of the metropolitan cities.

Use of study as a bench mark in suburban business districts.—One of the most important values of this study is that it can serve as a bench mark for possible future comparisons. It is hoped that the same tabulations can be made for the Metropolitan Washington area in future years so as to allow a time series evaluation of the growth and development of suburban business districts and to provide a test of the predictions made in the previous section. If this is done, it will be the first comprehensive study of the trends which are developing in suburban business districts for a whole metropolitan area.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

CONCLUSIONS AND RECOMMENDATIONS PERTAINING TO BUSINESS PRACTICE AND POLICY

Location factors.—The following step by step procedure has been developed and is recommended for the purpose of evaluating sites as potential locations for planned shopping centers.

1. Business districts in the vicinity of a site are mapped and trading areas are established for them on the basis of surveys of their patrons.

2. A potential trading area is established for the site on the basis of existing trading areas, transportation facilities, and local factors.

3. All available data are collected concerning the area established as the site's trading area. Census figures are, of course, basic and should include income figures by tracts, if available. The various secondary sources mentioned above are investigated and, if possible, utilized. This should yield reliable estimates of the population and income of the trading area as well as of the qualitative characteristics of its residents.

4. An interview survey is conducted in the area. The object of this survey is to refine the estimates of population and income, and to determine the desires of the people concerning lines of merchandise to be included in the center, services to be offered, and soon. The area random sampling method is suggested for use in this survey.

5. The results of the survey and the preceding analysis are employed to estimate the probable success of a center on any given site. Since location is almost always limited to several prospective sites, a comparative analysis will reveal the most profitable site for the new planned suburban business district.

Composite and layout.—Considerable study and many analyses were made of both the composition and layout of planned suburban districts of all types. In Table III, summary ratios are presented which indicate the frequency of occurrence of different kinds of retail stores and service businesses in the various kinds of centers. These are of value, along with studies of prevailing competition, in deciding upon the optimum composition of new centers.

The proper layout of each kind of center is treated separately in the dissertation because it has been found that each type has its own peculiar problems. Owing to space limitations it is possible merely to summarize some of the major points brought out in connection with the neighborhood centers.

1. The two volume stores in a neighborhood center are the drug and grocery stores. These should be placed at opposite ends of the center to create as much cross traffic as possible.

2. Branch post offices and branch banks, although they pay little rent, more than make up for this in the amount of traffic they draw to the small center.

3. When stores which are not essentially convenience goods outlets are included, care must be taken that there is a real need for them and that the lack of opportunity to shop and compare will not hamper the business to an extreme.

4. Accessibility and convenience to the immediate neighborhood are of paramount importance to this type of small center.

5. The parking ratio should be a minimum of 3:1 of parking area to selling area.

Table III

Number of Stores as a Ratio of the Number of Suburban Business Districts, by Type of Business District and Kind of Business, Washington Metropolitan Area: 1948

Kind of Business	Regional Districts	Shopping Districts	Neighborhood Districts
Apparel group	11.5	2.4	0.4
Eating and drinking places	7.2	1.5	0.4
Furniture, furnishings and applicance group	6.2	1.0	---
Gasoline service group	5.5	1.2	0.5
Grocery stores w/ and w/o fresh meat	3.7	2.7	1.2
Automotive group	3.2	0.2	---
Beauty shops	3.2	1.1	0.7
Laundry, pressing, cleaning, dyeing group	3.2	1.0	0.6
General merchandise group	2.8	1.0	---
Other food stores*	2.3	1.5	0.7
Drug and proprietary stores	2.2	1.4	0.9
Hardware group	1.7	0.7	0.3
Barber shops	1.7	1.0	0.2
Variety stores	---	---	0.3
Motion picture theaters	1.2	0.5	---
Bowling alleys, billiard and pool parlors	1.0	---	---
Shoe repair shops	1.0	0.3	---
Jewelry repair shops	0.8	0.2	---
Advertising services	0.5	---	---
Electrical repair shops	0.5	---	---
Photographic studios	0.5	---	---
Funeral services	0.5	---	---
Auto repair shops	---	0.2	---
Other retail and service establishments*	9.3	2.1	0.8

*Includes confectionery stores, bakery products, stores, meat and/or seafood markets, egg and poultry dealers, delicatessens, and other food stores.

*Includes all kinds of business for which there were less than 3 establishments

Source: Derived from Tables 14, 15, and 16 of the dissertation.

6. Whenever possible additional space should be available for future expansion.

7. Such centers average eight to ten stores, usually with combined sales of less than $1,000,000 a year. Investment should be kept in line with these expectations. The trading area will usually be less than one square mile and often as small as several city blocks. Its purpose is convenience to the neighborhood and this purpose should never be overlooked.

Other types of centers are accorded similar but more detailed treatment, specific recommendations varying with circumstances.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

CONTRIBUTION OF THE STUDY

The chief contribution of this dissertation is the statement and exposition of a scientific method for planning the location and layout of planned suburban business districts. This is not to say that the method presented is a complete answer to the problems of suburban business districts. Its chief limitation is imposed by the very fact that it is an attempt to apply the "scientific method." Like most such applications, it is time consuming and relatively expensive. In many cases these restrictions may prevent its use altogether; in other cases, short cuts will be necessary.

In spite of these limitations, it is felt that the method presented is a practical contribution to marketing operations. Its advantages over existing methods lie in the emphasis on factual information and competent research methods, which should contribute to a reduction in individual failures and social losses resulting from guesswork or the application of less scientific methods.

Microfilm $5.60; Xerox $19.60. 439 pages.

1. The Sanborn Maps are scale maps of all structures in the various urban areas of the United States. They are prepared by the Sanborn Map Company of New York City and are widely known for their accuracy.

Abstract published by special arrangement with The Ohio State University.

SOME ASPECTS OF EXPECTATION-FORMING IN THE FACE OF UNCERTAINTY IN AGRICULTURE WITH SPECIAL EMPHASIS ON FARMERS' UNCERTAINTY PREFERENCES, AS REVEALED EMPIRICALLY IN CLARK COUNTY, OHIO.

(L. C. Card No. Mic 59-5351)

John Alexander Boan, Ph.D.
The Ohio State University, 1953

Production economics must be concerned with uncertainty because of the phenomenon of time. When resources have to be committed before the outcome can be known, some assumptions about economic returns have to be made. These are expectations. Obviously, the efficiency with which resources are allocated will depend on how accurately expectations are conceived.

Allocating resources according to expectations that are not subsequently realized keeps total welfare below what is possible, since too much of one and too little of another product will be produced. Both the individual farmer and society as a whole stand to gain if errors in anticipations can be reduced and if the method of handling those that cannot be reduced can be improved. However, social steps to reduce inefficiency in meeting uncertainty involved policy. Therefore, it is a prerequisite to know what the farmers' reactions to and attitudes toward uncertainty are and how their expectations are formulated. The dissertation is devoted to the study of expectations in situations of uncertainty, the object being to try to learn more about the decision-making process. Specifically, it is an examination of a considerable body of current agricultural economics literature dealing with expectations; it reports the results of an empirical study conducted to find out more about farmers' attitudes toward uncertainty; and it examines some newer theories in economics and makes recommendations for further research.

Work done at Iowa State College and by the Bureau of Agricultural Economics demonstrates the tremendous amount of risk present in agriculture. Such risk may be grouped in two large categories: technical or yield uncertainties and price or market uncertainties. Some of the phenomena occur with sufficient frequency to permit estimation of some of the parameters of the distribution of outcomes; these are risks. This study, however, deals with expectations that are made in the face of uncertainty, that is, where the situation is characterized by meager knowledge, where decisions have to be made on the basis of limited information about the outcome, and where the actual data are supported in most cases by hunches about what the individual thinks may happen.

A survey of some of the agricultural economics literature concerned with expectations, decision-making, and planning indicates that the following conclusions are warranted.

With respect to the use of economic models in testing hypotheses about expectations, the interview method permitted qualified conclusions about the model used, but the use of secondary data of an aggregate kind was less satisfactory.

Much of the material consulted reported consistently the failure of prices to allocate resources, in any precise way, in the short-run. Farmers seem instead to respond only to relatively great changes when they expect them to be permanent.

Four of the studies under discussion reported attempts to discover farmers' reactions to uncertainty by the use of imaginary gambles of the radio-give-away type. However, their conclusions are vitiated by the fact that it has not been established that farmers make farm decisions in the same way that they would react in a radio studio while having a good time. If in the future it were shown that such a connection did hold, the technique would facilitate greatly the accumulation of knowledge about how farmers react to uncertain situations..

Evidence conflicted regarding whether preferences for uncertainty on the part of farmers were positive or negative. If there are two cost, revenue, or net revenue expectations within the same time period and with the same probable value, the individual who prefers the one with the least dispersion has a positive preference for certainty (a negative uncertainty preference), and the one who prefers the expectancy with the larger dispersion has a negative certainty preference (a positive uncertainty preference, i.e., he prefers uncertainty.) Whereas there are some people who fit into the latter category, preferring uncertainty, this is generally believed to be some kind of aberration; a rational person is assumed to have a desire for the outcome with the least uncertainty.

Under actual conditions it is difficult to make comparisons between ventures varying in uncertainty. If the dispersion differs, the level of the most probable price usually does also. So a person who prefers a venture with an acknowledged dispersion that is larger than the one associated with another venture is not necessarily irrational; he may be attracted by the much larger most probable outcome. The difficulty encountered in attempting to bring the phenomenon of risk preference down to measurable

terms is immense. Several writers, however, attempted to cope with it, but their results were not conclusive. For this reason and because of the importance both for theory and for practice of knowing more about uncertainty preferences, this aspect of expectation-forming was chosen for empirical study.

The impact on theory derives from the fact that the static analysis can be adapted to dynamic economics through assuming that entrepreneurs require a risk premium to bear the burden of uncertainty. The method of Hicks,[1] Lange[2] and others requires discounting the most probable price for uncertainty to obtain a "representative" or "effective" price. Thus a business plan can be viewed as a stream of expenditures and a stream of receipts through time. The rational individual will want the plan that maximizes the present value of the net receipts over time. To do this the following conditions must be met: (1) the marginal rate of substitution between any two planned outputs (or inputs) for any two dates must equal the ratio of their discounted expected prices, and the marginal rate of transformation of a planned input at any date into a planned output at any date must equal the ratio of their discounted expected prices. However, if uncertainty premiums were negative instead of positive, as assumed in the theory, it would mean that there were limitations on the usefulness of the marginal analysis in treating uncertainty. From the operational viewpoint, if uncertainty premiums were negative, it would mean that social measures adopted to reduce uncertainty (e.g., fixed prices) might have a different effect from that intended.

The major objective of the empirical part of the present study was to determine whether farmers in fact prefer a certain to an uncertain price. A farmer who indicated that he had no preference between a lower certain price and a higher, uncertain price would be classified as preferring certainty.

Minor objectives included studying farmers' notions about the results of fertilizer and their intentions to use it, and evaluating subjectively the method of interviewing as a technique for determining significant facts relating to farm decision-making.

The sample of farmers to be interviewed was selected randomly from a list of farms 50 acres and over in size, in Clark County, Ohio. The latter county lies in an area that is typical of corn belt agriculture, it has fairly homogeneous soil associations and farms that produce mainly livestock and dairy products. Since the sample came from only one county, generalizations developed from the data can apply rigorously only to that county.

Interviewing took place during the month of April, and 43 records were completed. The first four questions of the schedule were designed to determine the farmers outlook. Attention was given next to the product of the enterprise that the farmer felt was most important from an income point of view. He was then asked what price he thought was most probable for that product the following fall. After several questions of a minor nature had been asked, the farmer was requested to name the lowest certain price that he would take instead of the uncertain one that he had indicated earlier. If the certain price expressed was lower than the price considered "most probable," the farmer would be classified as preferring certainty, since he had discounted. But if he wanted more, it was evidence that risk aversion was not as prominent as had been postulated.

The conclusions regarding the minor objectives can be quickly stated. Fertilizer intentions did not reflect the pessimistic price outlook entertained by two-thirds of the farmers. Plans called for the same amount of fertilizer even though prices were expected to go down. Notions about the effects of fertilizing on yields were not at all precise. With respect to the interview method, the impression was that it was a highly useful technique but that it required experience, patience, and purpose. Farmers were found to be very willing to respond when they were convinced that it was not a sales talk and that it was in the interest of science.

The results concerning the major objective supported the conclusion that the farmers in the sample had negative risk premiums. That is, to be certain of the price, they would be satisfied with not less, but with as much or more than they indicated that they expected with the greatest probability.

Several reasons might be cited to explain these results. The farmer might have been unduly pessimistic, giving a lower price than he really thought might eventuate, and therefore he would be irrational if he would accept so low a certain price. Again, the individual might have been optimistic about yields, or because he was just beginning a new enterprise, and this would be reflected in his desire to take a chance on possible prices. However, when those who were anything but pessimistic, and those who gave a low most probable price were set aside, there remained ten (23 per cent) who nevertheless preferred uncertainty. Not one in the whole sample responded in the manner depicted by the theory. These results must be placed with those of Brownlee and Gainer[3] and D. B. Williams[4] as evidence that there are occasions upon which entrepreneurs would rather have an uncertain than a certain price for a future product.

If the results found respectively in the Iowa, Illinois, and Ohio studies referred to were applicable to farmers generally, it would involve two modifications in theory. The first concerns the effect attributed to risk aversion in agriculture, and the second concerns the use of the marginal analysis to study uncertainty.

It has been common in agricultural economics literature to associate risk aversion with capital rationing as factors explaining the existence of small, under-productive farms. But if risk aversion is not at all times positive, it cannot be responsible for small-scale farms. It may be that it is not risk aversion but the very opposite that induces a person to remain year after year on an unproductive unit in vain hopes that a trick of fate will some day cause large returns to be realized.

With respect to the marginal analysis in matters of uncertainty, it is plain that if risks do not consistently repel, but sometimes attract, it is useless to try to understand reactions to that phenomenon by assuming that entrepreneurs always discount.

The use of discounted expected prices would be useful only as a first approximation. With that technique, the farmer could select a most probable outcome to use as a bench-mark from which to choose the combination of resources that appealed most strongly. For instance, he might discount a price he felt was most probable by 20 per cent, and use this in the ratio of prices made tangent to the physical output curve to maximize returns. How much he discounted the most probable price would be a matter of individual judgment and taste. But the main

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difficulty with this technique is not that it is indeterminate, but that it assumes quite a bit is known about the probable distribution, and, if this is true, the phenomenon no longer can be classified as uncertainty, but as a "risk," in the manner that fire is considered by the insurance company, i.e., not everything, but sufficient is known about the distribution to make fairly clear-cut cost estimates possible. Uncertainty requires other techniques.

Two newer economic theories have considerable promise as behicles for handling uncertainty. Reference is made to "game theory," and to the formulation of G. L. S. Shackle.

Game theory deals with problems of strategy and with measurable utility.[5] It permits a complicated distribution of probability distributions to be reduced to one unique distribution of final outcomes, and thus greatly simplifies the problem of choice. The advantage of the game formulation in understanding entrepreneurial decision-making is that it can account for the desire to gamble. Thus a person who takes on a dull gamble may do so because the utility of the expectations exceeds the utility of the arithmetic mean of the expected returns.

Shackle makes at least two important contributions to the theory of uncertainty. He postulates, first, that an individual's expectations can be represented by a concept called potential surprise; and, second, that when a man is deciding whether or not to invest, he fixes his attention solely on two values that epitomize respectively what he stands to gain and what he stands to lose.[6]

His theory lends itself very well to explaining certain phenomena in agriculture, such as the increase in the use of capital during and just prior to World War II, for the policy of guaranteed prices may have acted to lessen belief in losses and therefore made investment opportunities look more attractive. It explains equally as well the attitudes of the farmers encountered in the survey in Clark County.

Shackle's theory also brings into focus the importance of understanding the causes necessary for certain beliefs to be held by individuals. He tends to take the individual's potential surprise as given. But in order to develop predictive value the factors causing potential surprise need to be isolated and identified. This is properly the province of psychologists.

Therefore, the assault on the understanding of the expectation-making process needs to be the work of a team in which psychologists would play an important role. Rotter, at the Ohio State University, has already gone some distance independently of economic theory to measure expectancy objectively.

Two recommendations are submitted. First, research should be continued in the field of uncertainty, with attention focused especially on the problem of expectations. The work would be most fruitful if carried out under the direction of a team representing various disciplines rather than by just one. In the team, psychologists should have a major role. Second, regardless of the work of a team of scientists, a study should be undertaken of the farmers who are considered to be the top ten per cent in terms of progressiveness to learn how they handle risky situations. Such a study would provide useful material for extension workers and for farm managers.

Microfilm $2.70; Xerox $9.40. 207 pages.

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Abstract published by special arrangement with The Ohio State University.

AN ANALYSIS OF THE WASHINGTON WHEAT MARKET RELATIVE TO FUTURES TRADING

(L. C. Card No. Mic 59-6472)

Bruce Lloyd Brooks, Ph.D.
Purdue University, 1959

Major Professor: Paul L. Farris

Uncertainty among the members of the wheat trade regarding the adaptability of the Washington wheat market to futures trading led to this study.

The importance of wheat to the economy of the State of Washington and the Pacific Northwest is further justification for this study.

The problems divides itself into two component parts:

1. An analysis of the present system to determine the strengths and weaknesses in the existing marketing system relative to futures trading.
2. An analysis and evaluation of some alternatives for futures trading of Pacific Northwest wheat.

The first step in the analysis is a description of this market, and its operation. A history and description of the Pacific Northwest wheat market determined the market characteristics of this market.

A review of literature revealed the characteristics of the commodity and the market that are necessary for successful futures trading. The next step was to establish and compare the futures market model with the Pacific Northwest wheat market. An active and successful futures market performs various functions. To enumerate and describe these functions was the third step. Analysis of secondary data determined how well the Pacific Northwest market performed the functions of a model futures market.

Logic, the review of literatures, and informal interviews with members of the trade substantiated performance or lack of performance of the necessary functions of a commodity futures market in the Pacific Northwest.

The third through the sixth part of the manuscript was devoted to evaluation of the Pacific Northwest wheat market and its potential as a futures trading market.

The results of this analysis show that various characteristics in the Pacific Northwest wheat market are

completely or sufficiently lacking to discourage the operation of a futures market in this area.

Part VII is an evaluation of trading alternatives for Washington wheat. This section is devoted to the second part of the problem. The acceptance of the conclusion that the operation of an active and successful Pacific Northwest futures market for wheat is not feasible leads to two questions: What are the best alternatives for the Pacific Northwest trader who wants to do some grain futures trading and, should a trader attempt to do any futures trading or would he be better off to hold cash wheat and take his risk on price change in the cash market?

The Chicago commodity futures market comes nearest to meeting these general criteria.

Results of this analysis of price movement showed that the Chicago market is most favorable of the three futures markets analyzed -- Kansas City, Minneapolis, and Chicago. This phase of the analysis shows that there still exists, for the Pacific Northwest trader, much risk of unfavorable price change on other grain futures markets because he is trading in a commodity and in a market not well adapted to his use.

A study of the adivsability of holding cash wheat and bearing the risk of price change compared wit: hedging on the Chicago Board of Trade was made.

Results of a comparison of gains or losses from holding cash or hedging show that the holder of cash grain in the Pacific Northwest gained more often than did the hedger for the same periods of time.

The possibility that the Pacific Northwest hedger finds the Chicago futures market a reasonably good hedge and at the same time finds an opportunity to realize a large profit as a result of a favorable change in basis may well be one of the reasons why a futures market in the Pacific Northwest has not flourished.

Marketing margins in this market are not significantly different from those for the Kansas City market.

Variations in wheat prices in the Pacific Northwest market have followed other markets.

Microfilm $3.65; Xerox $12.40. 284 pages.

A STUDY OF THE LONG RANGE COST OF UNEMPLOYMENT COMPENSATION AND THE VARIABLES THAT CONTROL COSTS IN OHIO

(L. C. Card No. Mic 59-5356)

Paul Gene Craig, Ph.D.
The Ohio State University, 1953

The Federal Social Security Act was passed in the summer of 1935, and under the stimulus of the tax "off-sets" outlined in Title IX of that Act, Ohio passed an Unemployment Compensation Law on December 16, 1936.[1] In passing the unemployment law and setting up a system of unemployment compensation, the Ohio General Assembly relied mainly upon the findings of the Ohio Commission on Unemployment Insurance, which were based on a study of the years 1920-1933.[2] As subsequent events have demonstrated, the compensable unemployment expectations of this period have proved far to pessimistic for the years since benefit payments began in 1939. Consequently, contribution rates have been generally lowered and benefit structures liberalized but reserves have continued to grow. Year after year, with few exceptions, unemployment has remained very low.

Ohio's reserve had grown to more than $600 million by December 1952. The unusually low unemployment of recent years and the large reserve fund have caused considerable discussion in Ohio as to whether or not (1) taxes should be lowered, (2) benefits liberalized, (3) the reserve fund reduced, or (4) some combination of these courses of action be taken.

PURPOSE OF THE STUDY

The general purpose of the dissertation is to arrive at some reasonable answers to the above questions, thereby bringing more actuarial soundness into the financial management of unemployment compensation. More specifically, this study attempts (1) To estimate the average cost of paying unemployment compensation benefits for the decade 1953-1962 under four reasonable alternative assumptions as to levels of covered unemployment during that decade; (2) To determine the effects upon these alternative cost estimates of possible changes in the benefit provisions of the unemployment law; (3) To formulate a reserve policy which clearly states the roll of reserves in sound financing of unemployment compensation; (4) To formulate principles of sound financing which include policy related to both reserves and contribution rates; (5) To evaluate the existing reserve fund and tax structure in light of the policies formulated and the estimated cost of benefits.

In order to carry out these five purposes, it is necessary to accomplish the following things:

1. Estimate the volume of covered unemployment in the period 1940-1952 a "composite unemployment compensation law"[3] similar to the 1952 Ohio Law had been in effect throughout the period. This is a problem of adjusting existing unemployment compensation data.
2. Estimate the volume of covered and compensable unemployment in the period 1920-1939 if the "composite law" had been in effect. This is a problem of constructing unemployment compensation type data from other data relative to unemployment and labor turnover (accession and separation rates).
3. Derive a reasonable range of assumptions regarding the possible legislative provisions and unemployment conditions under which unemployment compensation is likely to operate in the decade 1953-1962.
4. Determine the relationships among legislative and economic variables (levels and directions and rates of change in covered unemployment) and the cost of unemployment compensation.

These four essentials may be thought of as sub-purposes, but in many respect they are as important as the main purposes. Findings of more general use are associated with some of the sub-purposes rather than with the main purposes. Sub-purposes one and two give the perspective and background necessary for a full understanding of unemployment compensation and its cost. Sub-purpose four yields general results which go beyond the main purposes of this study. These relationships are significant for any unemployment compensation analysis and their applicability goes beyond the state of Ohio and beyond the economic conditions postulated in this study.

METHOD OF INVESTIGATION

The Empirical Background

The analysis essential to meeting the purposes of the study necessitated a background of empirical data comprehensive enough and covering a sufficient period of time to give perspective to the postulating done and to permit the determination of the associations among legislative and economic variables and costs. First, therefore, the existing data on unemployment compensation in Ohio had to be adjusted to make it reflect the composite law. Only then could the effects of economic variables be ascertained and the consequences of specific legislative changes be determined. This step involved adjustment for each historical change in the benefit structure since 1939.

Second, the limited range of unemployment levels since 1939 made it necessary to expand the existing unemployment compensation data by extrapolation from other data. On the basis of employment data collected by the Ohio Division of Labor Statistics and on file at the Bureau of Business Research, The Ohio State University, estimates were made for each month of the period 1920-1939 of the volume of covered employment in Ohio if the composite unemployment compensation law had been in effect. Constant monthly rates of growth in the covered labor force were assumed for each month of the 1920's and the 1930's and the two rates were computed, the July 1920, July 1929, and July 1940 covered labor force estimates serving as benchmarks. The 1940 benchmark was known from existing unemployment compensation data and the 1920 and 1929 benchmarks were derived by estimating a three per cent rate of covered unemployment to have prevailed in each of those years. Monthly estimates of the covered labor force were made on the basis of the rates of growth and the benchmark values. These were combined with the employment estimates to determine covered unemployment (absolute amounts and rates as per cents of the covered labor force).

Third, to estimate the portion of the covered unemployment that would have been compensable in the period 1920-1939 and to determine significant relationships among legislative and economic variables it was necessary to make distributions by duration of the covered unemployment estimates. This was done by the use of probability theory (ascertaining the probability of an unemployed person remaining unemployed during a particular month) and it required knowledge of the rate of turnover in the covered unemployment pool.[4] Separation and accession rates of the type needed were derived from the separation data of the Bureau of Labor Statistics (B.L.S.) by the use of linear regression equations, determined by the method of least squares, applied to the data of the period 1940-1952, during which both the B.L.S. data and unemployment compensation data were available.

After these steps were completed, a set of empirical data reflecting actual and estimated unemployment compensation experience for the long and economically diverse time span 1920-1952 was turned to. These data constitute the factual base on which the analysis of costs and of economic and legislative relationships were built.

The Legislative and Economic Alternatives

To determine the effect upon compensable unemployment and costs of alternative benefit provisions, it was necessary to arrive at reasonable assumptions about how future legislatures might change the Ohio Unemployment Compensation Law. This was done by analyzing the unemployment law in terms of (1) the philosophy and thinking on unemployment insurance of persons associated with the field, (2) the legislative trends in other states, especially the comparable industrial states, and (3) what may happen politically in Ohio as seen in the historical development of the unemployment law and the relative powers of the chief bargaining forces, organized labor and organized management groups.

One of the main purposes of the study is to estimate the cost of unemployment compensation during the decade 1953-1962 under reasonable alternative assumptions regarding the levels of covered unemployment. Four different patterns of covered unemployment are postulated. These patterns are based upon assumed reasonably possible courses of national and international events.

The volume of compensable unemployment is estimated for each of the four assumed cycle patterns by the probability method discussed above for the 1920's and 1930's. The turnover rates associated with specific unemployment rates of the cycle patterns were taken from the existing turnover data in the period 1930-1951. This was done by using for the cycle patterns turnover rates of the historical periods which most nearly approximated the unemployment conditions of the assumed patterns.

SUMMARY OF FINDINGS

The following constitute a summary of the major findings of the study.

1. Relative to average weekly earnings and living costs, weekly benefit payments in Ohio are lower in 1953 than they were in 1939.
2. Relative to the size of the labor force, fewer persons are now covered by unemployment compensation than were in 1939. This has resulted from a gradual increase in the occupational or industrial categories exempted from the Law.
3. Reasons for benefit disqualifications have become more numerous and the penalties imposed by disqualification have become more stringent since 1939.
4. These trends in benefits, coverage, and eligibility are not unique to Ohio. Ohio's benefit structure compares favorably with that of other leading industrial states. Out of a list of eight such states Ohio ranks third behind New York and Pennsylvania in liberality of benefit structure.[5]
5. Contribution rates have been substantially lowered and experience (merit)-rating differentials extended since 1939. Yet total reserves have increased in every year except two. Ohio's current reserve position is probably the safest among the eight mentioned states. Although its mean annual tax rate for the seven years 1945-1951 is the second lowest among the eight states,[6] Ohio has paid out proportionately less of these taxes in benefits than has any of the comparable states. Since the beginning of its unemployment compensation program, Ohio has paid out in benefits fifty-one cents of each dollar contributed. The next lowest ratio of benefits to revenues is that of New Jersey which has paid out sixty-three cents from each contribution dollar. Consequently, Ohio's reserve fund as of June 30, 1952 would have paid 10.2 years of benefits at the mean cost rate of the years 1946-1951. The industrial state with the next most favorable reserve, New Jersey, could pay only 6.3 years of such costs out of its reserves.
6. About 56 per cent more new claims determinations

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are disallowed under a twenty weeks worked in eligibility requirement than would be under a fourteen week requirement. Approximately 9.9 per cent of all new claims determinations are disallowed under the former, but only 6.35 per cent under the latter.

7. Approximately 46 per cent of the veterans compensated under the Servicemen's Readjustment Allowances program would have been eligible for benefits under the composite Ohio law. Had they received Ohio Law benefits, the mean annual covered unemployment rate for the years 1946-1949 would have been 4.56 per cent instead of the estimated 3:94 per cent, an increase of 12 per cent in covered unemployment.

8. Adjusted estimates of covered unemployment, including veterans under the Servicemen's Readjustment Allowance program, averaged 3.78 per cent for the years 1940-1951. Had the composite law been in effect, it is estimated that mean rates of covered unemployment for the decades of the 1920's and the 1930's would have been 10.96 per cent and 20.67 per cent, respectively.

9. It is estimated that if the composite law had been in effect, covered unemployment would have averaged 24.22 per cent in the depression years of 1921-22, 32.47 per cent in the years 1931-33, and 15.59 per cent in the years 1938-39.

10. Because of differences in the characteristics of claimants in the two periods, approximately 50 per cent more claimants fail to meet eligibility requirements (covered employment in twenty weeks) in periods of relatively full and stable employment or recovery than do in periods of recession in which unemployment rises above five per cent.

11. Eligible initial claims rates for Ohio are positively correlated with the sum of the "lay-offs" and "discharges" components of the Bureau of Labor Statistics separation data and reasonable estimates of the former can be made from the latter for the years 1930-1939.

12. Some previous state studies have assumed initial claims rates to decline as unemployment rises. This is the exact opposite of what was found for Ohio both in the years of unemployment compensation records and in the estimated experience of the 1930's. This is a very significant point for other states contemplating cost studies in which most data will have to be postulated.

13. When covered unemployment is rising, compensable unemployment rises less than proportionally. When covered is failling, compensable falls more than proportionally. Thus, generally, as covered unemployment rises, the relative portion of it which is compensable decreases. Therefore, the cost of unemployment compensation does not rise in proportion to increases in unemployment.

14. For any given volume of covered unemployment there is a tendency for there to be more compensable unemployment in the recession phase of a cycle than in the recovery.

15. The portion of covered unemployment which is compensable tends to be highest in the first year of a downturn. As a recession deepends and continues, the portion of the unemployment in compensable status declines until the lower turning point in the cycle is reached. This tendency is more pronounced the longer and the deeper the depression.

16. Corollary to findings 13, 14, 15 is the fact that a decade with two or more recessions punctuated by recovery will have more compensable unemployment than one with the same average rate of covered unemployment but only one recession. This has important implications for the cost of unemployment compensation in the future. The built-in stabilizers in the economy and the likely fiscal and monetary policy measures will probably be such as to make future cycle patterns ones of short and rather mild recessions following each other more closely than have the more severe recessions of the past. This would cause the cost of unemployment compensation to be greater than a casual inspection of unemployment rates might suggest. Specifically, it would mean that relatively more of future unemployment would be compensable.

17. The portion of unemployment compensated depends upon the levels of unemployment and the types and time dispersion of the recessions which yield these levels. Generally, three patterns of compensation are discernible:

(a) Over the years studied, averaging good times and bad, about 62 per cent of covered unemployment is compensable.

(b) In periods of very little unemployment, five per cent or less, about 71 per cent of covered unemployment is compensable.

(c) In periods of high unemployment, ten per cent or more, about 45 per cent of covered unemployment is compensable.

This clearly demonstrates that the present system of unemployment compensation is best designed to handle the unemployment problems of a relatively prosperous economy which experiences only mild recessions. It compensates most adequately that unemployment attributable to the normal vicissitudes of a dynamic industrial economy in the process of adjusting to changing patterns of demand for commodities and types of labor.

18. If the Unemployment Compensation Law were changed so as to impose no disqualification on persons who voluntarily quit their employment without "just cause" or who are discharged for "just cause," the volume of compensable unemployment would be increased about five (5.26) per cent in periods of recession with more than five per cent unemployment and by about ten per cent (9.89) in periods during which there is less than five per cent unemployment.

19. The effect upon compensable unemployment of an increase in the maximum potential duration of benefits is always less than proportional. The extent of the increase in compensable unemployment is dependent upon the levels of unemployment and the duration of the period of depression. Generally, the relative increase in compensable unemployment is greatest for a given volume of unemployment in a decade when that unemployment results from just one recession. The exact increase in cost owing to an increase of the maximum duration must be analyzed for each different economic situation; no fixed rate of increase is generally applicable. In a year such as 1932, raising the maximum duration from twenty-six weeks to thirty-one weeks, a 19.2 per cent increase in duration, would increase compensable unemployment by 17.6 per cent. In a decade such as that described in Pattern I (average unemployment of 2.5 per cent) the same increase in the maximum duration increases the volume of compensable unemployment by only 4.2 per cent.

20. Under any one set of legislative assumptions, the range of average cost rates for different cycle patterns is much smaller than the range of average unemployment

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rates. This disparity between the cost and unemployment rates becomes more pronounced as higher unemployment rates are postulated.

21. A system of financing unemployment compensation should not attempt to balance costs and revenues on a year-to-year basis. Cost variations from year-to-year are much greater than the cost variations among different decades or different cycles. Greater stability in tax rates and financial programing can therefore be achieved by balancing costs and revenues over a period of time about equal to the time span of an average business cycle, seven to ten years.

22. The largest reserve fund found necessary under any of the economic conditions of this study and the 1952 benefit structure adjusted to pay a $30 maximum weekly benefit is $553 million. Thus under any of the assumed economic conditions Ohio can finance part of its unemployment benefits out of existing reserves, which were about $624 million as of December 31, 1952 and had approached $650 million by June of 1953.

23. Assuming the 1952 benefit structure adjusted to pay a $30 maximum weekly benefit, if use is made of "excess" reserves and interest earnings, Ohio will need an average annual tax rate ranging from 0.58 per cent of average taxable payrolls under the most favorable conditions of Pattern I to 2.15 per cent under the least favorable conditions of Pattern IV. Pattern II with covered unemployment averaging 4.9 per cent of the covered labor force may be thought of as the intermediate favorable assumption and would require an average tax rate of 1.43 per cent. Pattern III with an average covered unemployment rate of 6.9 per cent would require an average tax rate of 1.91 per cent of covered payrolls. One may conclude that in all probability needed taxes will be in the range between one and two per cent and that the tax rates of the post war years will not be adequate to finance unemployment compensation in a normal peacetime economy.

Microfilm $5.45; Xerox $19.20. 427 pages.

1. 116 Ohio Laws 286.

2. Ohio, Commission on Unemployment Insurance, Report, Parts I and II, Columbus, Ohio: F. J. Heer Printing Co., 1932 and 1933.

3. The composite law, with a few minor exceptions, is a hypothetical construct similar to the 1952 Law. It was used to simplify statistical analysis. Covered unemployment consists of those persons who are unemployed, have filed a valid claim for benefits, and have been able to meet eligibility requirements. As thus defined, it includes three groups of persons: (1) those waiting to receive benefits, (2) those receiving benefits, and (3) those who have exhausted their benefit rights but are still unemployed.

4. Turnover is the result of accessions (exits from the unemployment pool) and separations (entrants into the pool).

5. The eight states by order of liberality are New York, Pennsylvania, Ohio, Illinois, New Jersey, California, Michigan, and Massachusetts. Liberality of benefit structure as here used refers only to the benefits a claimant may receive if he is not disqualified from benefits. Thus this ranking of "liberality" does not necessarily indicate overall liberality of the unemployment compensation program.

6. The lowest rate is 1.00 per cent of taxable payrolls recorded for Illinois; Ohio's rate is 1.04; and the highest rate is New York's 2.09 per cent.

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EMPLOYMENT TRENDS IN THE TEXTILE INDUSTRY, 1947 - 1957.

(L. C. Card No. Mic 59-6203)

James Roy Ott, Jr., Ph.D.
Vanderbilt University, 1959

Supervisor: Professor E. J. Eberling

This study has two major objectives. The first is to systematically present the employment trends in the Textile Mill Products Group--Standard Industrial Classification Industry Group #22--at its two, three, and four-digit levels. This is done for the entire nation and for the regions and states in which the bulk of the industry is located. The second objective is to identify and analyze the economic forces generating these trends with particular reference to the basic spinning, weaving, and finishing sectors on the national level.

By many measures of economic well-being the textile industry in the postwar period--especially in the present decade--has been in considerable distress. Profits, prices, and wages have been low; total physical production has not increased in volume; and employment has been in a secular decline. Despite these evidences of distress, the industry remains an important one in the manufacturing sector of the national economy. In 1957, it ranked eighth in employment out of twenty manufacturing groups. In that year it employed approximately six percent of all manufacturing workers in the nation, and fourteen percent of those in the non-durable manufacturing sector.

The industry's scope and boundaries are described in Chapter I. In addition, its important economic characteristics are discussed.

Employment trends are portrayed in Chapters II and III. Data are taken from: a) the current employment statistics program of the Bureau of Labor Statistics; b) the wage structure reports of the Division of Wages and Industrial Relations of the Bureau of Labor Statistics; and c) the censuses and surveys of manufactures of the Bureau of the Census. These reveal that the industry sustained a decline in employment of approximately 330,000 workers (25%) from 1947 to 1957 with most of it occurring after 1951. Within the industry, the sharpest decline in both absolute and relative terms was in the woolen and worsted sector. Cotton and synthetic yarn, and broadwoven fabric mill employment declines were also sizeable. Regionally, the employment losses were sharpest in the New England and Middle Atlantic states. The Southeast, by virtue of relative stability of employment throughout the period, increased its dominance as the textile center of the United States.

The results of the Bureau of the Census analysis by electronic computer method of six continuous national employment series each having a duration of 132 months are presented in Chapter III. These are: Total Textiles, Yarn and Thread Mills, Broadwoven Fabric Mills, Knitting Mills, Dyeing and Finishing Plants, and Carpet and Rug Mills. The seasonal and trend-cycle components of the

series are identified by this method and summary measures and graphs developed. The seasonal factors, both stable and moving, display well defined patterns of mild amplitude with peaks for most series occurring in the spring and fall and troughs in July. The trend-cycle data reveal the secular decline present in almost every one of the series, and the fact that following each recession employment failed to recover its pre-recession height. Also, a clear picture is provided of the two-year cycle in textile employment. This conforms in periodicity with the cycles observed in other textile economic series such as raw material consumption and spindle and loom operation. Like them, it appears to be dampening somewhat over time.

The remainder of the study is directed toward the second major objective mentioned above, namely, to identify and analyze the economic forces generating these short-secular employment trends. Only those forces relating to the national industry are considered, and chief, although not exclusive, attention is given to basic textiles. The fundamental factors responsible for the postwar declines appear to be two. One relates to domestic demand and is the subject of Chapter IV. While giving rise to noteworthy shifts among fibers, demand has done little more than sustain relatively stable total production in spite of the rapid increase in total population and per capita income. The absence of an appreciable growth element in textile consumption series is attributed largely to: a) increased competition in traditional textile markets from non-textile materials such as paper, plastics, glass, rubber, and metals, and b) vigorous competition from numerous dynamic industries for the consumer dollar.

On the other hand, the industry's man-hour output has increased significantly in the past decade. This second fundamental factor responsible for employment declines is examined in Chapter V. In the basic industry, the increase was from approximately 7.8 yards per man-hour in 1947 to 11.7 in 1957. Utilizing thirty-five percent fewer man-hours in 1957 than in 1947, the industry produced only two percent fewer years of fabric. This conclusion of sizeable increases in man-hour output is reinforced by evidence emerging from case studies of mills or groups of mi'ls. The chief factors accounting for this increase are: a) technological developments, b) improved management techniques, and c) changing fiber composition of output.

The effects on textile employment of government policies in the areas of agriculture and foreign trade are considered in Chapter VI. These have effected hardships on certain segments of the industry, but are not found to be as fundamental or pervasive over the period of this study as those mentioned above.

Microfilm $4.15; Xerox $14.00. 324 pages.

INVESTMENT DECISIONS IN INDIAN ECONOMIC PLANNING

(L. C. Card No. Mic 59-6313)

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Syracuse University, 1959

Supervisor: Sidney C. Sufrin

The purpose of this study is two fold: (1) to attempt a critical survey of the prevailing theoretical discussions concerning investment allocation in underdeveloped countries, with a view to appraising their operational usefulness to planners in these countries, and evolving alternative approaches where necessary and feasible; and (2) to examine the allocation strategy underlying the two Indian five-year plans in the light of the conceptual approaches referred to above.

Given the total volume and rate of investment in the economy, development planning presupposes the application of specific investment criteria as guides to assigning priorities and allocating the investment fund among the various sectors, and in choosing between alternative production techniques and projects in each of these fields. The scope of the present study is limited to an appraisal of investment decisions in regard to sectoral allocation and the choice of techniques and projects.

This study is primarily analytical in method. In analyzing the theoretical viewpoints regarding investment criteria, books and periodical articles were the basic materials used. Publications of the Government of India and related public documents provided the basis for the appraisal of the Indian plans.

The major conclusions of this study are the following: (1) The theoretical analysis presented in Part I has brought into focus the nature and causes of the divergence between the various investment criteria relevant to sectoral allocation and to the choice of techniques and projects. These differences stem, partly from the divergent views of the process of growth held by their proponents, and partly from the differing policy goals and value judgments implicit in their respective approaches. The present study shows that differences of this sort cannot easily be resolved and that as long as they remain, there cannot be any uniquely objective and rational criteria for investment choice.

(2) Our appraisal of the allocation strategy of the two Indian five-year plans in Part II clearly shows that investment allocations have been determined by social cost-social benefit considerations rather than by reference to any of the conceptual approaches discussed in Part I. An examination of the divergence between the theoretical approaches to investment allocation and the actual criteria used for investment choice in the Indian programs reveals the tremendous influence of non-economic factors and competing policy goals on investment decision making, and testifies to the limitations in applying economic criteria based on marginal analysis to situations involving structural changes, as in the case of India.

(3) Although a broader approach to investment choice based on social costs and benefits is desirable, the neglect of economic considerations can make the process of economic growth unduly expensive for a country. An analysis of some aspects of the allocation strategy of the Indian five-year plans shows that a better appreciation on the part of the policy makers, of the real opportunity costs of alternative investment choices to the economy, could have resulted in more efficient investment allocations both at the sectoral level, and in choosing between alternative techniques and projects. This underscores the important role economic criteria can play in providing planners with a knowledge of the costs to the economy, in economic terms, of alternative investment policies to achieve given goals. Viewed from this standpoint, the framework for sectoral allocation and the frame of reference for the choice of techniques and project proposed in Part I, have

have a modest contribution to make as analytical aids to planners in underdeveloped countries.

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SOME IMPLICATIONS OF THE EMPLOYMENT PATTERNS OF WOMEN UNDER SOCIAL SECURITY

(L. C. Card No. Mic 59-3443)

Ella Joan Polinsky, Ph.D.
The American University, 1959

Statement of the Problem

Among the less scrutinized aspects of the extraordinary employment trend of women in recent decades, is the extent of their participation in the Old-Age and Survivors Insurance Program. The major research problem of this thesis was to throw light on the extent to which women, by their wage credits in covered employment, were acquiring rights to social security retirement benefits.

Procedure

Changes in the age, employment, insurance status and earnings characteristics of women in covered employment were analyzed for the two decades since social security tax deductions began in 1937. Also considered, was the effect on the employment, insurance status and earnings mix, of the influx of older women from about 1950 and the broad extensions of coverage after 1950. The relationship between total and taxable earnings of men and women were compared to establish the significance of the sex differential in earnings as a factor in the retirement prospects of women.

Findings and Conclusions

Despite the considerably larger numerical increase for men than for women in the total of workers in covered employment between 1937 and 1957, the relative increase was substantially greater for women.

The number and proportion of part-year workers among women was large but relatively stable. The ratio of women four-quarter to less than four-quarter workers was approximately 60:40 during the two decade span regardless of economic conditions. In part, this reflects the independent restraint of family responsibilities on the employment activities of women.

Nearly 60 percent of all living women workers in the insurance system were insured on January 1, 1958. This represents a quadrupling of the proportion of women insured in 1940. Mostly, the higher recent proportion insured reflects the administrative liberalization of the eligibility requirements for insurance status rather than a significant change in the duration of employment of women. In effect the "new start" formula bestowed, restored, and maintained insurance status.

The ratio of taxable earnings of women to taxable earnings of men was considerably greater than the comparable ratio of their total earnings. Since a portion of the wages and earnings of men were not counted in the benefit computations, this reduced the percentage replacement of total earnings of men on retirement. Since practically all of the lower earnings of women were taxable, their replacement percentage was relatively higher than for men.

Not enough time has elapsed to evaluate the retirement implications of the employment and earnings patterns of the older recent female entrants and re-entrants. If, as is expected, their employment patterns will be longer than in past years, the ratio of female to male earnings credits will rise per year employed regardless of differences in wage rates by sex.

In the next several years the effect of the "new start" formula will permit increasing numbers of fully insured but comparatively short-term workers to retire as primary beneficiaries, or as auxiliaries who receive a smaller benefit on their primary accounts than as entitled dependents.

In the more distant future, under a mature insurance program, more years will enter into the benefit computations. The zero earnings of married women during years of heavy family responsibilities will be averaged with earnings credits during years of employment. This will reduce the replacement percentage of permanently insured married women workers with substantial employment and earnings credits.

However, more women will be eligible to receive primary benefits. To the extent that husband and wife primary benefits exceed the single primary benefit of the male bread-winner and the pro-rated benefit of his dependent wife, the living standards of the family will have greater income protection in the retirement years.

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THE ECONOMIC EFFECTS OF THE REDUCING CHARGE METHODS OF DEPRECIATION

(L. C. Card No. Mic 59-3143)

Donald Leroy Richard, Ph.D.
The American University, 1959

The problem was to determine the economic effects of the reducing charge methods of depreciation allowed in the Internal Revenue Code of 1954. The declining balance method and the sum of years' digits method, which are allowed in the new Code, provide for highest depreciation charges during the earliest year of asset use and steadily declining charges in later years. They are thus referred to as reducing charge methods.

Single asset investments, total investments of growing firms, capital gains, and other firm influences were first examined. Theoretical examples were developed to illustrate their various effects. The extent of use of the methods, the revenue effects, and other aggregative effects were then studied.

The reducing charge methods were found to give increased rates of return and greater availability of funds. The payoff period is shortened, and additional benefits are given by the methods when used in conjunction with capital gains. The study of price effects indicated little possibility of change except in highly competitive or regulated industry. The analysis of dividend effects did not indicate any important effects, and a less liberal dividend policy seems doubtful.

In the past five years there has been a considerable trend to the use of reducing charge depreciation with the study indicating about 80% of the companies using the methods. No serious structural effects were found except for

those in relation to small business, which since then has received additional benefits in the Technical Amendments Act of 1958. National statistics regarding depreciation have become uncomparable and distorted due to the varied methods used and the methods being unrealistic for some assets. General productive efficiency will undoubtedly increase through the greater quantities of equipment, the better physical condition of equipment, the improvement in equipment quality, and the stimulus to more research and development.

A liberal but reasonable estimate of the contribution of the reducing charge methods to the rate of growth seemed to be about 1/2%. The assumptions on availability of funds indicated a possible increase of about 3/8% and in addition to this the higher rate of return and capital gains effects are operative. It seems certain the reducing charge methods could not provide a desired increase of 1% or 2% in rate of growth.

The tax revenue loss is not a serious problem, for although revenues are lost in the early years, the stimulus to growth tends to modify the early losses and to overcome them in the later years. A 2% reduction in tax rates will give a comparable dollar benefit to the corporate taxpayer, but it is clear that it would not accomplish the selective investment stimulus desired. Effects regarding state taxes seem unimportant, but where local taxes are based on book values, considerable change in tax revenue and investment stimulus is indicated.

The overall economic effects of the reducing charge methods are clearly valuable to both the firm and the economy. They should be retained as a part of the tax code because of their stimulus to investment, as well as their generally realistic approach to income measurement. The reducing charge methods have contributed to the aims of Congress for economic growth, increased production, and higher standards of living to a small degree, but not to the extent desired. In any further legislation to stimulate investment, either generally or selectively, an "investment deduction" should be allowed rather than changing depreciation methods.

Microfilm $2.55; Xerox $9.00. 196 pages.

THE GAINS FROM FOREIGN TRADE IN RELATION TO THE UNDERDEVELOPED COUNTRIES

(L. C. Card No. Mic 59-6072)

Seh Hyuck Ryu, Ph.D.
University of Cincinnati, 1959

Today there still exist proponents of the Classical free-trade theory predicated on the principles of comparative advantage, international specialization and the gains from trade involved in unhampered international commodity exchange. This theoretical framework is problematic, especially in the particular case of the underdeveloped countries. The usual analytical result is that such nations should specialize in primary production, at the expense of industrial manufacturing.

Criticism can be advanced on several different grounds. On the basis of static reasoning, i.e., barring progress in technology, primary production tends to be subjected to increasing-cost condition upon expansion. Although the resultant decrease in national productivity may favor the barter terms of trade via the relative scarcity of primary products (relative to manufactured goods whose industries tend to expand under decreasing costs), this improvement of the barter terms for primary products may not suffice to offset the unfavorable consequences of specialization upon the national income of the underdeveloped countries.

A second major defect of the Classical comparative cost theory lies in its tendency to be too static in its underlying assumptions. Many of its proponents deduce the advantages obtainable from specialization and free-trade policy simply on the basis of currently prevailing international cost and price differentials, treating their determinants virtually as immutable and failing to make allowance for the possibility of profound changes over time.

A third short coming of the Classical model lies in the narrowness of the concept of gains from trade. Gain merely refers to an increase in national income resulting from specialization and free trade, compared with isolation. Insufficient attention is paid to the question of the commodity composition of imports as well as to distributional aspects. Moreover, in any discussion of optimal foreign economic policy, social, cultural and political values must be considered aside from purely economic-materialistic ones. For the underdeveloped countries, specially those of the South Asian area, the colonial pattern of specialization in primary products has been instrumental in fostering what is known as the "plural society," i.e., a high state of social, economic and racial disintegration. The recent abandonment of colonization does not promise abandonment of this disintegrated state of affairs so long as the economy remains in its highly specialized form. The one-sided emphasis on primary production tends to perpetuate the pluralistic pattern of society.

Economically as well as culturally and socially, a trend toward industrialization is indicated. Such industrialization cannot proceed without some form of protectionism. However, this study does not suggest blind and indiscriminate resort to tariffs, import quotas, and exchange control. It merely suggests the desirability of a thorough change in the commodity composition of imports through such restrictive devices. On the theory that free-trade imports have meant a heavy component of foreign luxury items consumed only by the wealthy groups of society, and on the theory that such consumption patterns have been aggravating the economic, social and political gulf that exists between them and the masses of natives, it is suggested that imports should be shifted in the direction of low-priced mass consumption items and capital goods. This type of foreign trade policy could have beneficial effects upon the energies of the masses of native workers according to the "law of consumption." Such stimulation of energy is indispensable for economic development.

Microfilm $2.70; Xerox $9.20. 205 pages.

DEVELOPMENT OF A HOG EVALUATION SYSTEM FOR PACKING PLANTS

(L. C. Card No. Mic 59-6515)

Norton Eugene Smith, Ph.D.
Purdue University, 1959

Major Professor: Clifton B. Cox

Meat packing plants are faced with increasing numbers of alternative markets from which to buy hogs. Changing prices complicate the job of deciding where to buy. Research indicates that decreasing lard and fat pork cut prices relative to lean cuts caused values of hogs to spread, making accurate hog evaluation more difficult. If hogs are not accurately priced according to value, producers will not be encouraged to produce hogs which provide consumers the most satisfaction.

The objectives of this study are to test, under marketing conditions, a packing plant hog evaluation system and its potential worth, and to determine the relative importance of selected factors as they affect the average value of lots of hogs.

The 30,295 hogs slaughtered in a selected packing plant during 16 days of operations were observed for carcass weight, grade, and tattoo identity. The carcass data were associated by automatic machines. Associations included tattoo numbers with the purchase data of total weight, number of hogs, source of purchase, and shrink for each lot of hogs. Carcass value was compared with pounds purchased to determine the average live value per hundredweight of each lot. Factors of average purchase weight, yield, grade, and weight deviations of each lot were associated with average value and source of purchase.

Four selected factors, average weight, yield, grade, and weight deviations significantly affected average values of lots of market hogs. Average weight was the most important, yield was second most important, grade was third, and weight deviation was fourth. Average weight was nearly three times as important as yield while yield was more than twice as important as grade in determining average value. Weight deviation was more than half as important as grade.

Values of lots of hogs were analyzed by source of purchase. Consistently more valuable lots of hogs were purchased from one source than another even when purchased in the same weight group at the same price.

Hogs purchased to average within the 200-219 pound weight group averaged nearer the midpoint of the range (210 pounds) when purchased from farmers than when purchased from another source, local markets, which had re-sorted the hogs (214.2 pounds). Average weight differences of only two or three pounds may cost a meat packer thousands of dollars a year.

Yield of 200-219 pound lots appeared significantly different between two of the three sources studied. The hogs from the source which indicated a significantly higher yield were purchased closest to the point of slaughter while those with the lowest yield were transported the furthest indicating tissue shrink may have caused the difference.

No significant difference in yield was noted among the three sources (each in a different state) when different weights and classes of hogs were included.

Shrinkage was somewhat associated with yield ($r = .415$). One percent increase in shrinkage appeared to account for roughly .3 percent decrease in yield.

Lots of hogs purchased directly from farmers appeared to vary more widely as to value within weight groups than those purchased from markets which had re-sorted farmers' lots. However, hogs purchased from farmers were of greater average value than hogs in the same weight bracket purchased from markets.

The wide range of average lot values within given weight ranges indicates pricing of hogs by weight schedule is less than reasonably accurate.

The outstanding importance of average weight in determining hog values suggests that buyers and sellers on terminal markets might weigh hogs before determining price rather than estimating weights in arriving at price as is now done.

Pooling farmer's hogs by grade and weight in the interests of achieving greater pricing efficiency through larger price differentials for grades would create greater pricing inaccuracies unless yield was considered.

Average weight, yield, grade, and weight deviation data from all or a sample of hogs slaughtered may be secured through a relatively inexpensive system to provide a packer information on the value of hogs purchased. The advantages and disadvantages of purchasing hogs from different markets can be more accurately quantified, permitting better-informed decisions by the packer as to where hogs can be purchased most economically.

Accurate reports from a systematic evaluation method could be a valuable tool in the bilateral bargaining which usually takes place when packers buy hogs. Definite hog specializations could be made as provisions of the packer's agreement to buy at a price.

An important effect of using a system would be improved recognition of value on the part of sellers as a result of increased buyer accuracy, which would provide increased pricing efficiency in hog marketing. Increased hog pricing efficiency would encourage producers to reallocate hog production resources so that consumers would realize greater satisfaction from pork products for the same or fewer resource expenditures.

Microfilm $2.50; Xerox $4.80. 91 pages.

JURISDICTIONAL DISPUTES AMONG THE BUILDING TRADES UNIONS

(L. C. Card No. Mic 59-5835)

Kenneth Thomson Strand, Ph.D.
The University of Wisconsin, 1959

Supervisor: Associate Professor David B. Johnson

Jurisdictional disputes and jurisdictional strikes among the building trades unions have long been a problem within the construction industry. The purpose of the study was to determine the cause and best method of accomodating jurisdictional conflict among the building trades unions.

Research procedures were an examination of the literature, field interviews, employment experience, and an analysis of relevant law.

Part One discusses the environment of jurisdictional conflict--the structure of the construction industry and the nature of the building trades unions. Part Two examines the causes of jurisdictional disputes and jurisdictional strikes. Part Three is an account of the attempts to

accomodate jurisdictional conflict--the historical attempts, the passage of jurisdictional strike provisions of Labor Management Relations Act, 1947, and the origin and operations of the National Joint Board for Settlement of Jurisdictional Disputes. Part Four, after a statement of premises derived from Parts One through Three, analyzes the relationship between the National Labor Relations Board's decisions under Sections 8(b)(4)(D) and 10(k) and the operations of the National Joint Board for Settlement of Jurisdictional Disputes. The concluding chapter suggests that the National Labor Relations Board alter its policies or that the Labor Management Relations Act, 1947 be amended.

Conclusions: Jurisdictional conflict is the product of deep seated psychological, political, and economic forces operative within the employment environment of the construction industry. Jurisdictional conflict is inevitable, but not all forms of jurisdictional conflict must be accepted. Jurisdictional disputes, claims to work, are less objectionable than jurisdictional strikes to enforce such claims. Jurisdictional disputes and strikes are interrelated because claims have no effect without a strike threat. Jurisdictional strikes can be reduced if a substitute is found. Recognition and acceptance of the union concept of job ownership by contractors who employ union craftsmen and by settlement procedures can serve as a substitute for the jurisdictional strike. The only valid private jurisdictional awards are those which stem from procedures wherein all interested parties have a voice. The Joint Board is such a procedure. The flaw inherent in the Joint Board plan is the lack of power to enforce its awards and to stop jurisdictional strikes. All previous settlement plans have failed because a lack of enforcement powers. The Taft-Hartley Act procedures, while unsuited for settling jurisdictional disputes, can enforce jurisdictional awards and stop jurisdictional strikes. Thus, if the Act is administered to strengthen the Joint Board procedures, an effective method of accomodating jurisdictional conflict can result. The administration of the Act has been spotty. Certain decisions strengthen the Joint Board, others weaken it. The administrative policy should shift or the Act should be amended. Proposals for both alternatives are offered.

Microfilm $6.90; Xerox $23.80. 542 pages.

INDUSTRIAL RESEARCH AND DEVELOPMENT AND THE NEW COMPETITION—A STUDY OF THE LEADING EMPLOYERS OF RESEARCH AND DEVELOPMENT PERSONNEL BY INDUSTRY GROUP AND BY SIZE OF FIRM

(L. C. Card No. Mic 59-5246)

James S. Worley, Ph.D.
Princeton University, 1958

This dissertation seeks to fulfill two purposes. It compiles and analyzes lists of the 100 largest employers of research and development personnel in 1927, 1938, 1950, and 1955. Special attention is paid to changes in the composition of this group of firms. Its second purpose is to ascertain whether the distribution of research and development employment is consistent with the New Competition--a concept which emphasizes the importance of firm size and oligopoly power as determinants of a firm's research and development activity. Since oligopoly power is not readily quantifiable, major stress is placed upon the role of firm size.

The major findings are:

1. Total research and development employment, and that accounted for by the 100 largest employers, has been concentrated in five industry groups: transportation equipment, electrical machinery, chemicals, petroleum, and electrical communication. The last has fallen from prominence and the first two groups have replaced chemicals and petroleum in importance in the postwar period. The shift in industry group locus is attributable to government support in aircraft and electircal machinery.

2. Research and development employment is highly concentrated, more so than is output. The 100 largest accounted for an estimated 40 per cent of industrial research and development employment in January, 1954. However, concentration may have declined slightly since 1927. Concentration is also high within the 100 largest, but has declined since 1927.

3. Fifty-nine firms appeared in at least three lists and accounted for a high proportion of total personnel in each of the lists. Thus the concentration of research and development employment has largely been vested in the same firms since 1927. Although this group's share has declined recently, the decline is explained by the heavy orientation of government sponsorship of research and development toward aircraft and electrical machinery.

4. Output and research and development employment concentration are partly interrelated. From 36 to 51 of the 100 largest firms (on an asset basis) appeared among the largest employers of research and development personnel on the various dates. Forty-one of the 59 consistent leaders in research and development employment appeared consistently among the 100 largest firms. However, there is no high correlation between rank orders of appearance.

5. In any fundamental sense, the New Competition is not substantiated. If this concept possesses basic substantive content, it should imply that the intensity of research and development effort is a function of size. This hypothesis is tested by correlating research and development employment per unit of assets with asset size for the largest firms in eight major industry groups. Very low correlations are obtained; indeed, in most cases they are negative. Furthermore, asset size is not a particularly good predictor of research and development employment. While it is true that research and development employment is concentrated in the 300 largest firms, thus showing that size exerts an influence, this influence is hardly greater than one would expect between size and practically any other variable. Thus the study concludes that present size levels are not necessarily optimum with respect to research and development employment and that one need not necessarily fear that interference with existing size levels will involve high social costs via a reduction in innovating activity.

6. It is suggested that a firm's research and development employment is the product of a more complex set of variables than size and oligopoly power and that the influence of certain other characteristics--e.g. the relative ease of discovery of new products, the closeness of the firm's association with chemistry and physics, the growth of the firm, and the role of patents--should be analyzed.

Microfilm $2.50; Xerox $8.20. 179 pages.

ECONOMICS, AGRICULTURAL

COST OF MILK PRODUCTION ON 138 LOUISIANA DAIRIES

(L. C. Card No. Mic 59-5506)

Howard Wilfred Anderson, Ph.D.
Louisiana State University, 1959

Supervisor: Dr. F. H. Wiegmann

Numerous economic reports show that costs of producing milk have increased at a rapid pace since World War II. Contributing to this increase has been the rising costs of the factors of production. During this same time, prices received for milk by Louisiana dairymen have not increased but, in many cases, have decreased. This development has resulted in a "price squeeze" for dairymen, and economic adjustments have become necessary. This study was made to determine investment, labor, and size of operation necessary for a family size dairy unit in Louisiana.

Business analysis records for 1957 on 138 Louisiana dairy herds enrolled in Extension's Farm and Home Development program were used as basic data in this study. The herds were located in 14 parishes and represented four geographical sections of Louisiana. Expense and income records were obtained from the farmers by the Agricultural Extension agents in the parishes and were authenticated by sales slips, canceled checks and receipts. Since no records were available, total hours of labor were estimated by the agents.

For the major analytical purposes three cost categories were used: i.e. (1) cash costs, (2) cash costs plus depreciation on buildings (four per cent per year), equipment (eight per cent per year) and interest on investment (four per cent per year) and (3) total costs, which included (2), above, plus the value of unpaid family and operator's labor (at 50 cents per hour).

Most of the costs were related to total pounds of milk produced per farm per year, and various cost comparisons were made on the basis of 100 pounds of milk produced. The statistical method used was linear regression. Weighted averages were used in computing costs as related to average production per cow, number of cows in the herds, and per cent distribution of production costs.

Average total costs of producing milk on the 138 dairy farms was $5.47 per 100 pounds as compared to $5.54, the average price received for the milk. This shows that the industry was close to an economic "equilibrium" during 1957. A minimum production of 178,000 pounds of milk annually was necessary before total milk receipts equaled total costs, whereas only 135,000 pounds must be produced in order for gross returns to the dairy to equal total production costs. Fixed costs declined and variable costs increased as production per year increased. The data indicated that better use of the factors of production could be made when a minimum of about 200,000 pounds of milk was produced annually. Investment per 100 pounds of milk produced decreased as production per year increased. In the distribution of costs, purchased feed constituted the largest item in either cash costs (49.29 per cent), cash costs plus depreciation and interest on investment (40.19 per cent) or total costs (33.33 per cent). Value of all labor (paid and unpaid) comprised 22.34 per cent of total production costs. Total hours of labor varied greatly between herds at each level of annual production. This variation indicates that many dairy operators are not making the best use of labor.

According to these data, a family size dairy unit in Louisiana must have a minimum of about 35 cows averaging approximately 5,000 pounds of milk per cow per year in order to produce enough milk, have enough volume to overcome "overhead" costs, and produce a fair labor income for the family.

Microfilm $2.50; Xerox $4.80. 91 pages.

PREDICTION OF FERTILIZER CONSUMPTION IN TWO REGIONS OF THE UNITED STATES

(L. C. Card No. Mic 59-6567)

John Ronald Brake, Ph.D.
North Carolina State College, 1959

Supervisor: Richard Adams King

The purpose of this study was to derive a technique with which fertilizer consumption could be predicted for two regions of the United States. The two regions were the South Atlantic region and the East North Central region.

It was necessary to consider several characteristics of the industry to evaluate the alternatives with respect to a time of year for the prediction to be made. Productive capacities, time lags in the supplying of materials and contracting for the materials were reviewed. The release dates for the data which are necessary for predicting were found to be most restrictive. It was suggested that preliminary predictions be made in the late spring preceding the beginning of the fiscal year to which the prediction applies and that a revised or final prediction for the fiscal year be made in the late fall or early winter preceding the important spring consumption period.

The method of least squares was used in the derivation of prediction equations. The models were of four types: (1) traditional multiple linear regression, (2) first difference linear regression, (3) models with cubic terms in time and (4) distributed lag models. The predetermined or predictive variables used in the regressions were justified on the basis of economic analysis.

Besides the usual goodness of fit criteria for regression techniques, comparisons were made with respect to the ability of the equation to predict accurately in the 1950's. Each equation was solved for the regression coefficients for each year from 1950 through 1957 using data from the period 1930 through 1957. Then the coefficients estimated for each year were used to predict consumption for the following year. In some cases, the prediction obtained in this manner was considerably poorer than when fitting one equation to the entire period. Equations were selected for use on the basis of the above comparisons, the width of their confidence intervals and their theoretical acceptability.

The results were compatible with the hypothesis that different factors are important in affecting fertilizer consumption in the two regions. The price of fertilizer was indicated to be a significant factor in both regions. Crop income, including government payments, and the planted acreage of tobacco were significant factors in the South

Atlantic region. For the East North Central region, there was some evidence that land values affected fertilizer consumption, indicating substitution of fertilizer for land in the production of crops.

Predictions and projections of consumption were made for the fiscal years 1959, 1960 and 1964. To illustrate the use of the equations, predictions were made for fiscal 1959 and preliminary predictions were made for fiscal 1960. Finally, fertilizer price elasticity estimates from distributed lag equations and projection of crop acreages with estimated fertilization rates per acre were used to project consumption for 1964. These projections indicated about a 7 per cent rise in fertilizer consumption for the South Atlantic region in 1964 compared with 1958 and about a 20 per cent rise in consumption for the East North Central region. Microfilm $2.50; Xerox $5.80. 118 pages.

DETERMINATION OF TABLE EGG PRICES IN A DEFICIT AREA IN RELATION TO CENTRAL MARKET QUOTATIONS

(L. C. Card No. Mic 59-5519)

Harry Ellis Hathaway, Ph.D.
Louisiana State University, 1959

Supervisor: Dr. E. P. Roy

Any pricing system must register and report prices accurately reflecting market values. Prices should facilitate efficient egg marketing and allocate all resources equitably. Formerly, and at present, egg pricing based on central market quotations was utilized, even in egg deficit areas. It is hypothesized that it could be a disadvantage for the local producer of high quality to base prices on eggs of lower average quality in central markets. Lack of usable market egg news emphasizes the need for improved market news reporting techniques.

Spot call trading on the Chicago and New York Mercantile Exchanges is the basic price-registering mechanism in the egg market. The number of participants on the exchanges is very small. Volumes of eggs traded on the spot calls are less than one per cent of total eggs received in the two markets. Thus, the accuracy with which the spot calls of the two exchanges register market value at any level is doubtful, especially for deficit production areas.

Prices reported daily from Chicago and New York Market News Services are near to and fluctuate with the Mercantile Exchanges' price quotations. Louisiana egg buyers base their paying price on these price reports. This price is usually based upon a wholesale classification (60% A Quality Large) while grade-yield returns of locally produced eggs range from 80% to 90% A Quality. This latter system of pricing eggs in a deficit area apparently ignores quality differences between central market "wholesale" classifications and locally produced "consumer classifications."

In examining egg price differentials between a Baton Rouge price and Chicago-New York prices, the greatest differential was +15.23 cents per dozen for Baton Rouge over Chicago and +11.26 for Baton Rouge over New York in December 1954. The differentials listed for the Chicago and New York markets during 1957 were within the four cents differential reportedly used by Louisiana egg buyers. Therefore, it is doubtful whether in 1957, Louisiana egg buyers considered quality a factor in their price determination for Louisiana produced eggs. An arithmetic ratio of (the wholesale price per dozen) is to (the per cent A quality in the classification) as (the price that should be paid) is to (the A quality yield of local eggs) is used to obtain an adjustment price for A quality yields of locally produced eggs.

Louisiana egg buyers use several methods of determining their offer price for locally produced eggs. The most common method is to use a central market reported price and add or subtract transportation charges. Louisiana egg buyers offered, in 1957, a range of plus four cents to minus four cents per dozen from the base price for eggs purchased from local producers.

Seventy-nine per cent of the eggs purchased by twelve Louisiana egg buyers based on four selected months in 1957, originated from out-of-state, while 21 per cent were Louisiana produced. During this period, 38 per cent of the eggs handled were packed in a consumer Grade A classification, and 62 per cent were packed in a Candled Current Receipt classification.

Federal-State Market News egg and poultry reports from Kansas and Louisiana for 1951-1957, contained irregularly 74 different grade, size, and color egg classifications in wholesale and consumer grades. This type of market news reporting of egg prices is obsolete; therefore, a revised system is needed. Presented is a model report designed to eliminate the confusion which exists for users of the report and to offer other needed information.

Further research suggested by the dissertation includes devising new and imaginative pricing systems for table eggs based on consumer demand for eggs, shortening the marketing system, and allocating the residual to egg producers. Microfilm $2.50; Xerox $6.60. 140 pages.

ECONOMICS, COMMERCE — BUSINESS

AN INVESTIGATION INTO THE EFFECTIVENESS OF CERTAIN FACTORS IN RETAIL COLLECTION CORRESPONDENCE

(L. C. Card No. Mic 59-5345)

Donald Vinson Allgeier, Ph.D.
The Ohio State University, 1953

In recent years, with consumer credit at an all-time high, the problem of retail store collections has become more acute than ever. Since letters constitute one of the most commonly used methods of collecting retail accounts, the credit man is naturally interested in knowing how such letters can be improved. Accordingly, the dissertation is a discussion of the effectiveness of retail collection letters and the methods by which they may be improved.

A sizable portion of retail store customers are charge account customers. In 1951, the last year for which accurate figures are available, charge account sales represented 19 per cent of the total sales for the country, or

29.2 billions of dollars. These figures represent an increase over previous amounts, and the largest increase was in nondurable goods.[1] In the Dallas Federal Reserve District, where this study was conducted, charge sales for 1951 showed greater strength than either cash or installment sales.[2] It has been estimated that about one-half of all retail stores in the United States sell at least some of their goods on credit. About two-thirds of the credit sales, as distinguished from installment sales,[3] are charge account sales.

Of these charge customers, a large number will not pay their accounts when due. Many perfectly honest customers allow their accounts to become delinquent. It is necessary to put into effect some sort of collection system in order to induce them to pay. The writer's investigation bore out the contention of some authors on the subject that the traditional 30-day charge account has become, to all intents and purposes, a 90-day account. Customers expect to be granted extra time and most stores allow it. This is called a "courtesy period by Phelps."[4] The stores do not make a very serious effort to collect accounts during this period. They content themselves with sending additional statements, often accompanied by form reminders on cards or reply envelopes. Such reminders merely assume that the paying of the debt has been overlooked.

In view of these facts, many of the people charged with the responsibility for retail collections are re-examining their policies and systems to handle the large volume of accounts and to meet the attitude of the customers toward the traditional 30-day account. Letters remain a very important part of any collection program. They are relatively inexpensive and are effective in many cases.

Much has been written on the subject of collections by mail. However, there has been no statistical evidence regarding what methods are most effective in collecting retail charge accounts. So-called "tested" letters were not really tested under scientific conditions. Such tests as have been conducted have involved very few cases. There are no accurate data to prove or disprove the beliefs of credit men regarding which types of letters work best.

One factor which makes the collection letter difficult to write is the necessity for keeping the customer's goodwill while still collecting the debt.[5]

The purpose of the study was to test various types of collection letters in actual use in order to determine, if possible, which factors make a letter succeed and which psychological appeals are best in motivating the customer to pay.

The principal procedures used in this research study were:

(1) Some 560 questionnaires were mailed to credit men and letter writting experts in order to obtain ideas to use in formulating the methods of approach and the criteria for judgment. Many interesting facts about present-day collection procedures were also obtained in this way. Of 509 questionnaires to credit men, 83 usable replies were received, or a percentage of 16.3. The other 51 were sent to members of the American Business Writing Association, who returned 22, or 43.1 per cent.

(2) Library research was employed to ascertain the amount of work previously done and to obtain background information.

(3) Seven hundred letters actually used by 85 stores were gathered and analyzed.

(4) Tests were made of nearly 5000 letters sent to charge account customers of the eight co-operating Texas stores.

The study was concerned only with retail stores of the three following types: department stores, women's specialty stores, and men's clothing stores. Only charge account customers were studied, not budget or installment account customers. Only collections by mail came within the scope of this research, and particular emphasis was placed on letters at the beginning and the end of the series of collection attempts usually made.

Because of the shortage and rapid turnover of help, as well as the large volume of accounts, only one or two stores made any attempt to deal with delinquent customers on an individual basis. Form letters were used almost entirely. It was for this reason that the writer made most of his tests of a specially-prepared form letter against a reproduced form letter of the store. The main differences between the letters involved references to the amount and past history of the account. These differences could be handled readily by using an individually-typewritten form letter and rewording it, where necessary, to include the facts about the particular account. The ability to make such changes easily is a big advantage of the typewritten form letter. In addition, it looks like a personal letter.

The letters prepared by the writer were designed to be informal, friendly, and personal in tone, and as free from cliches as possible. Name salutations were used. They were mailed by the stores on store stationery. The writer went into most of the stores and examined the accounts receivable ledgers or the files of delinquent customers. The names taken from these sources were grouped according to length of delinquency, since it was felt that this was the most important characteristic the debtors had in common. This was in accordance with the opinions of such writers and authorities as Beckman and Held[6] and Loughridge.[7]

In each mailing the number of the store's printed form letters with fill-ins sent to the control group was approximately the same as the number of individually-typewritten test letters sent to the test group. In addition to testing individual letters, data were obtained on the results of the entire series sent to the list of customers at 30-day intervals.

On the basis of replies to the preliminary questionnaires and the analysis of possible procedures, the following criteria were used as measures of the success of the collection letter: full payment in a reasonable time, part payment, and a promise or explanation. Naturally, a promise received does not indicate as much success as a full payment. However, it means the letter was at least partially successful. The writer realizes that the fact that a payment is received following the mailing of a collection letter does not necessarily mean that the letter is responsible. There is a cumulative effect of several letters, and other factors may have influenced the decision to pay. However, the payment is a tangible and measurable response and the others are not. Certainly, the letter is responsible for the payment in many cases. Also, the cumulative effect would probably be similar for both groups. Therefore, reliance was placed on tangible responses from the debtors.

The primary psychological appeals tested were the appeal to fairness (tested approximately 90 to 120 days

after the due date); and the appeal to self-interest (tested approximately 7 to 8 months after the due date). Also, a number of tests were made of the final appeal, often called the appeal to fear,[8] with significant results. Although only a comparatively few tests were made of the appeal to pride, the results will be reported along with the rest, since these four appeals seem to be those most commonly used, according to the author's surveys.

The results of the tests are shown in Charts I through III. It will be noted, by comparing Charts I and II, that the test letters achieved better results, except in the case of the appeal to pride, which included only a few cases, as has been explained.

CHART I*

Effectiveness of Test Letters

	0 10 20 30 40 50 60 70 80 90 100%
Fairness	//////////////////////// 63.1%
Pride	/////////// 31.6%
Self-interest	//////// 25.4%
Fear	///////// 29.1%

CHART II*

Effectiveness of Store Form Letters

	0 10 20 30 40 50 60 70 80 90 100%
Fairness	////////////////////// 57.9%
Pride	////////// 32.5%
Self-interest	//// 12%
Fear	///// 14.3%

CHART III*

Effectiveness of Series

	0 10 20 30 40 50 60 70 80 90 100%
Test Letters	///////////////// 43.7%
Store Letters	////////////// 38.5%

*(Source: Original Investigation)

On these charts, the results in total payments and partial payments are combined for ease of handling and to show the total monetary response. When statistical techniques are applied to the differences shown in order to determine their significance, it is found that the percentage of difference in the last two appeals could not have resulted from chance or from sampling errors. The difference can only be attributed to differences in the quality of the letters. The differences shown in the pride and fairness appeals were found to be insignificant. That the fairness appeal showed no significant difference is not surprising in view of the belief of many experts that, in the early stages of collection, personalization and individuality are less important. These letters, the first ones mailed, were sent out when the delinquency had merely begun.

The results of the tests were also validated by comparing the test group and the control group regarding some of the more common variables. It was found that they contained virtually the same components of local and out-of-town customers, a similar variety of occupational classes, and a very similar spread of amounts owed. Therefore, it is felt that the two groups were definitely comparable.

Chart IV shows the varying results of the different psychological appeals as compared with each other. Here the appeal only is tested, not the personalization or impersonality.

CHART IV*

Relative Effectiveness of Main Appeals
(All Letters Combined)

	0 10 20 30 40 50 60 70 80 90 100%
Fairness	////////////////////////// 60.6%
Pride	/////////// 32.1%
Self-interest	/////// 20.1%
Fear	//////// 25.3%

*(Source: Original Investigation)

The following conclusions have been derived from this research study, and may be used to establish principles for the retail collection letter:

1. Persistent, regular, and continuous attempts to collect an account will result in eventual success in most cases.

2. In the early stages of delinquency, attempts to personalize and individualize the letter are not likely to cause any great improvement in results.

3. In the later and more serious stages of delinquency, a more friendly, personal, and individual letter, free from stock phrases, is definitely more effective.

4. The best letter for these late stages of delinquency is the personally-typewritten form letter, which appears to be a personal letter, and which can be typed to include items pertaining to the specific account, although the essential structure of all the letters for a certain period is identical.

5. More evidence is needed regarding the effect on goodwill of collection letters; however, it appears that the friendly treatment, even in a firmly-worded letter, will result in a strengthening of the friendliness of the customer toward the store.

6. Of the four main appeals used, the appeal to fairness appears to draw the most responses in proportion to the number mailed. However, this may be due in part to the fact that it was used near the beginning of the delinquency.

7. The usual collection series, as found from a study of many stores and many collection letters, is approximately as follows: (1) a letter asking if there is an error in the account; (2) a letter asking for an explanation; (3) a letter suggesting that the debtor come to the store for a talk; (4) an appeal to pride; (5) a letter stressing the importance of credit and how the credit system works; (6) a fairness appeal; (7) a self-interest appeal; (8) an appeal to fear. Other special-purpose letters also used are a letter for sending when a partial payment is received, a letter for small accounts, and a letter to be sent when a promise to pay has not been kept.

8. The most common criticisms of collection letters

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

in use today, based on the writer's surveys, are impersonality, triteness and lack of originality, lack of courtesy and you-attitude, lack of grammatical correctness, negative tone, use of words outside the usual vocabulary, and failure to mention the amount due.

9. As the delinquency increases in dollar amount, the number of debtors tends to decrease in a direct ratio.

10. It is probable that more than half the overdue accounts of the type of stores studied will amount to $50 or less.

11. Over 60 per cent of the metropolitan store's charge accounts are likely to be within the city itself.

It is also recommended that the collection letter writer compose his own letters to fit his own store's policies and type of customers, and that he keep records of results and do some research of his own into the effectiveness of his store's collection system.

Finally, it is recommended that further research be carried on in the area of collections. The writer recognizes that this study does not give the final word on the subject. The conclusions are meaningful, but more study is needed in some areas in order to arrive at broader, more basic conclusions regarding the most effective methods of collection.

Microfilm $2.50; Xerox $8.20. 178 pages.

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Abstract published by special arrangement with The Ohio State University.

THE PROBLEMS OF STENOGRAPHERS AND SECRETARIES IN RELATION TO THE LITERATURE AVAILABLE FOR THEIR USE

(L. C. Card No. Mic 59-6700)

Kathleen Rainwater Barnard, Ph.D.
The University of Texas, 1959

Supervisor: Dr. J. G. Umstattd

The purpose of this study was to determine the common problems of those employed in the secretarial field and the relationship between those common problems and the literature available for their solution.

Four hundred forty stenographers and secretaries throughout the United States cooperated in the study by supplying data on a rather lengthy questionnaire. They made recommendations for strengthening secretarial handbooks. They also indicated duties which they performed and stated whether or not there was sufficient material available in reference books to aid them in performing those duties proficiently. The duties in which a large number of them indicated insufficient material were as follows:

Typewriting charts and graphs
Typewriting statistical material
Typewriting legal documents
Taking minutes of meetings in shorthand
Composing and typewriting programs
Designing business forms to be printed
Keeping a tickler file
Monitoring telephone calls
Composing and writing letters on own initiative
Composing and writing invitations and announcements
Keeping up to date on knowledge of postal and shipping services and using a postal manual
Performing bookkeeping activities
Selecting office equipment

Reference books were analyzed to determine whether or not they contained adequate information on each problem area. The results of the study indicated problem areas in which each reference source contained adequate or inadequate material, or none at all. There seemed to be a sufficient amount of material available in reference books to aid stenographers and secretaries in performing most of their duties. However, in some secretarial duty areas, there was an insufficient amount of material available.

Other conclusions were drawn, and recommendations were made for the improvement of the reference materials and for in-service activities for the promotion of professional growth. Microfilm $3.80; Xerox $12.80. 293 pages.

EXECUTIVE JOB EVALUATION IN THE INSURANCE INDUSTRY

(L. C. Card No. Mic 59-6621)

Edward Harry Bowman, Ph.D.
The Ohio State University, 1954

Scope and Method of Study

This study is of executive job evaluation in the insurance industry. It represents a search for new knowledge concerning the objectives, difficulties, and general methods of such an evaluation. Salary administration is also probed. Economic theory is employed for its contributions. The attempt is made to discover what actually is happening in the administration of executive job evaluation and to present an analysis of the findings. Some work exists on the a priori theory of executive job evaluation, and, of course there are also statistical summaries of the Securities Exchange Commission and similar sources. Little material exists on the actual administrative problems involved. It is felt that the dissertation critically presents new information of an empirical and institutional nature.

Inconsistencies are revealed, and a synthesis is made between economic theory and the real world.

Primary information was obtained successively from (a) an intensive observational study, involving hundreds of hours, of one company, (b) interviews with seventeen companies, and (c) sixty questionnaire returns. The seventeen companies interviewed were mostly in Boston. The questionnaires were sent to insurance companies doing business in New York State (in addition to other states). Twelve case studies of insurance companies and their executive job evaluation and salary administration programs are included in the body of the report.

The Executive

An organization depends on its executives for direction and coördination, and the quality of the management supplied by these executives is, in large part, responsible directly or indirectly for the manner and degree in which the organization fulfills its purposes and satisfies its responsibilities. The quality of management supplied by a group of executives with given skill is largely a function of their motivation. Base salary is very pervasive as a motivating agent. Not only is salary important in and of itself, it is also the starting point for most bonuses and other forms of extra financial compensation, and it is directly associated with status in our economy and culture. Also, a salary plan which allows for differences in individuals, which is at least partially developed by the executives themselves, and which allows a superior to give just and diligent treatment to a subordinate will obviously be more acceptable than one which misses any of these characteristics.

Wage Economics

The contribution of wage economics to executive salary determination in the form of marginal analysis is only as an explanation of tendencies. It is an indication of how salaries would be determined under conditions of perfect competition, conditions which economic writers are quick to point out do not actually exist for numerous reasons. Due to market imperfections, therefore, although tendencies are present, there exists a range of prices which is wide in many cases within which administrative decisions must supplement the imperfect market. Demand for executive services, regulated by marginal revenue analysis, is really a measure of the relative importance of the executive position to the firm. Also, the supply of executive services, regulated by phenomena similar to marginal cost analysis, is really a measure of the relative difficulty of the executive position and its demands. The administrative function of executive job evaluation is necessary because of the imperfect market mechanisms associated with executive services, and, therefore, attempts to supplement them.

Objectives of Executive Job Evaluation

The objectives for executive job evaluation, cited by those companies in the insurance industry which were observed, interviewed, and contacted, were fairness, an aid to staffing, and cost control. By far the most important seemed to be the first, fairness. This objective was identified with morale and executive motivation. Fairness of course is a relative concept. A comparison must be made within the company, within the industry, and within the community. The fairness of the price paid by a company for coal or wheat is not questioned by the administrator making the purchase, nor the vendor making the sale, as a close approximation of a perfect market determines what is fair. To be fair in its compensation of executives, a company must attempt to approximate what a more perfect market would take care of automatically. However, fairness is not enough; the method of determining executive salaries must appear to be fair to the executives. As the important point in question is the reaction of the executives to their salary and its determination, these executives must first understand how salaries are determined, and then be convinced that they are fairly treated by this method. It was observed that many companies fall short of the first requirement, in that sufficient effort is not made to have the executive group understand the method by which their salaries are determined. This is one of the big disadvantages of a rather informal system of executive salary determination. Even though it might be eminently fair and thorough, it is difficult to explain and comprehend. A big advantage of a formal system of executive salary determination is its formality — its system. Formality is of course not the same as fairness. However, formality and the time put into developing a formal program for determining executive salaries suggest to the executives the intention of fairness.

Although one of the objectives most commonly cited was that of cost control, the use of control reports of some kind for this purpose was not common. The practice of some companies in this respect might well be followed. In addition to some form of rate range, these companies compile a periodic report which shows the relative placement of executive salaries within the established ranges for the different organizational components of the business. In this manner a particular department which is loose or tight is brought to light. Some companies also follow the practice of establishing a coördinated salary increase budget yearly, rather than treating each individual salary increase as if it were unique. The total increases must fit within this budget.

Difficulties of Executive Job Evaluation

The difficulties in executive job evaluation most commonly encountered were company growth and the fact that the man makes the job. The latter is merely recognition of the fact that, especially at the executive level, it is impossible to define completely the organization regardless of the particular men placed in the executive positions. If initiative is encouraged, and a survey of the formal merit rating plans which are used reveals that it is, then a creative individual is bound to have some influence on the nature of the position.

Both of these difficulties are essentially connected with salary administration. For the program to have any validity, it must be current; change, of course, makes this difficult. It follows that the ability to cope with this change should be provided for in any plan undertaken.

Another difficulty observed was that of choosing factors, if this was to be the system, which adequately represent the worth of the job. A further difficulty is caused by the multiple-comparison nature of salary administration. Comparison seems necessary within the company, within the community, and within the industry. As imperfections do exist in this market, these comparisons will not in all cases yield the same result. Industry and community comparisons should only be used to determine the general trend of executive salaries. What is desired is a line of regression portraying this general trend.

Not only was a lack of proper communication of the

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methods of executive job evaluation observed, but also a lack of written policy regarding executive job evaluation, particularly for the top executive level.

Methods of Executive Job Evaluation

With respect to particular formal systems, of those companies observed in the insurance industry, about one-eighth had formal systems of executive job evaluation for their administrative management positions, while over one-half had formal plans for their operative management positions. There was a preponderance of point systems at the supervisory level, while the less formal systems were more popular for the top executives. Where formal systems were not used, it was observed from the comments of the top executives who actually made the evaluations or salary decisions that what they were actually trying to do was approximate the market. The market they were trying to approximate is imperfect and their knowledge of it is imperfect.

An attempt is being made to supplement the imperfect forces of the market and to determine what price a perfect market would result in. Demand and supply determine market price. Importance and difficulty are factors of a position which represent respectively these market influences. A survey of the many factors used reveals that they can be fitted into these two factors.

The use of an abstract definition of factor levels is difficult at the executive level. Therefore, frequently key jobs are used to illustrate the levels.

Where a formal program of executive job evaluation and salary administration had been installed, although a consultant frequently aided in the installation, there was a high degree of company participation. Only infrequently has a consultant made an installation independently.

The most common executive job evaluator was found to be the committee. At best, executive job evaluation is merely systematic. Judgment is required, and the process is subjective. A favorable morale level is the main objective. A committee of respected executives would seem to make the best evaluator.

Executive Job Descriptions

Evaluations, if made formally, were usually done from job descriptions. These descriptions were made mainly from interviews with the particular executives. The participation of the executive's superior in the job description was very high, through either preliminary interview or draft review. This is not surprising since job definition is a major form of organizing, which is one of the primary functions of an executive. Most descriptions are actually written by specialists. Where descriptions do exist, there is a widespread use of them for purposes other than executive job evaluation.

Executive Salary Administration

When a program is installed, it is necessary to establish the relationship between points (the relative evaluation within the company) and money. The salary survey producing a scatter diagram (points vs. money) was the common way of establishing this relationship. This is the basic assumption of salary administration: although the market is imperfect and can not be relied upon to supply salary information for a particular job, it does supply the underlying trend of salaries, which is accepted as a guide. Also, as a rough geometric trend is observed between points and money in the market, it is not necessary to establish this relationship a priori. It is empirical. With this guide an administrative decision must be made as to whether a particular company will pay more or less than the market.

Few companies place salary limitations (such as a range) on top executive jobs, but over half place such limitations on operative management positions. Where a formal range did exist, a 50 per cent salary spread was found to be the median. Where a series of salary grades existed, there was a preponderance of salary grade progression in the range from 10 per cent through 19 per cent. Merit, though not necessarily formally rated, is by far the most common means of placement within salary range. Formal merit rating is not very widely used for executives, even at the supervisory level. Though most companies give only secondary consideration to seniority in determining placement within salary range (usually raises), it was frequently found that after a certain number of years without a raise (3 to 4), a raise would usually be given to prevent morale deterioration. The bulk of the raises given were in the range from 5 per cent through 9 per cent.

Summary of Recommendations

1—Importance and difficulty should be the two factors around which an executive job evaluation system should be built, if factors are to be used. They correspond to demand and supply as market forces.

2—Administrators should realize that they are, in effect, compensating for an imperfect market by their decisions and systems. The market should be relied upon for the underlying trend of executive salaries.

3—Management should make an effort to appear to be fair, in addition, to being fair, in executive job evaluation. This may be facilitated by:

(a) Formal systems including job descriptions
(b) Adequate communication
(c) Written policies
(d) Formal merit rating systems

4—Salary control reports should be used to help meet the objective of salary expense control.

5—Constant attention should be given to executive job evaluation and re-evaluation to keep up with job change and company growth.

6—Key jobs should be used in evaluation because of the difficulty of using only abstract definitions of job or factor levels.

7—If the system is to have an administrator, he should help develop it.

8—Evaluation of executive jobs should be made by a committee consisting largely of operating executives.

9—Salary ranges should be provided in order to reward superior performance of the job. Formal merit rating systems will help in evaluating this performance.

Microfilm $3.80; Xerox $13.00. 296 pages.

Abstract published by special arrangement with The Ohio State University.

LABOR TURNOVER: AN HISTORICAL SURVEY, WITH SPECIAL REFERENCE TO CURRENT PRACTICE IN SMALL AND MEDIUM-SIZE COMPANIES.

(L. C. Card No. Mic 59-5767)

Joseph Henry Foegen, Ph.D.
The University of Wisconsin, 1959

Supervisor: Associate Professor George Strother

Strictly speaking, turnover refers to employee-initiated job changes that constitute a cost and morale problem for individual firms. It has been considered with varying degrees of interest by individuals, companies, and government since 1897, with the Bureau of Labor Statistics reporting most of the formal and continuing studies.

Regardless of interest level, however, a comprehensive survey of the subject has, so far as is known, never been undertaken. The few books in the area cover wider aspects of the problem i.e. labor mobility, and/or were published too long ago i.e. 1900-1925.

The data collected by the Bureau are drawn primarily from larger companies in each reporting industry. This concentration on large firms maximizes coverage and minimizes clerical work, but also results in rates which, it is believed, understate the problem, since large firms today generally have better turnover experience than smaller ones.

To correct the first situation and to "prove" the bias suspected in the second, the extensive material published by the Bureau of Labor Statistics, as well as the opinions of other "experts" in the field, was reviewed. The development of interest in turnover, the history of the collection and computation of statistics, trends and movement in, and relations between turnover components, as well as extensive material on costs and causes of, and remedies for turnover were synthesized.

In addition, a survey of 621 Wisconsin firms, in the 90-1000 employee group, was taken to determine whether or not these firms thought turnover was a problem, whether or not, and to what extent they kept turnover records, the effect of turnover on management policy, what firms were doing to curb turnover, and what their separation rates were for 1957. In a series of interviews, the replies of a selected number of respondents were reviewed.

The literature showed that: 1. Most interest in turnover occurred during major wars, when labor was critically needed. 2. Pioneering efforts in collecting data were made by the Metropolitan Life Insurance Company, and the program, absorbed by the Bureau of Labor Statistics in 1929, is currently being decentralized to the states. 3. Turnover rates have declined over the past decades. 4. Turnover costs, often submerged in overhead, are estimated to range from $36 to $25,000 per person. 5. Quits and layoffs vary inversely with each other. 6. Quits increase disproportionately in prosperity, layoffs in recession; discharges are relatively constant. 7. Considerable stability exists coincident with turnover, and turnover, though usually considered a liability, also has positive values for workers, employers and society. 8. Evidence of the effects of unions on turnover is largely inconclusive. 9. Transfers, as internal turnover, are often overlooked. They are potentially as disruptive as the more conventional external variety. 10. Just as no single cause of turnover exists, neither does any panacea; on the contrary, an almost unlimited variety of often overlapping factors exists.

Conclusions from the mail survey, based on a 53.3% response, were: 1. Turnover was not a major problem to the companies replying. 2. Of those surveyed, small firms showed up less favorably than did large ones. However, turnover was generally low, averaging just over 2% monthly, or about half the average national rate. 3. The gross separation rates for both the smallest and largest firm-size categories were higher than for those in between. 4. The size of the gross separation rate bore little relationship to whether or not a company considered turnover a problem. 5. Layoffs accounted for a large part of total separations.

The personal interviews expanded the questionnaire replies, and in general supported the conclusions gleaned from the literature.

Microfilm $6.20; Xerox $22.20. 504 pages.

AN EVALUATION OF THE FUNDAMENTAL CHANGES IN THE PHILOSOPHY OF PERSONNEL ADMINISTRATION FROM MANIPULATION TO MOTIVATION

(L. C. Card No. Mic 59-5518)

Mohamed Adel A. M. Hassan, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Leon C. Megginson

This study shows the fundamental changes in the philosophy of personnel administration that have occurred because of the scientific management and industrial psychology movements. This work explains the underlying philosophy of scientific management and its effect on manipulating human behavior in industry. It also indicates the importance of the field of motivation and incentives in labor-management relations.

An extensive library survey of management literature constitutes the basis of this study. An evaluation is made of the contributions of industrial engineers and industrial psychologists and sociologists to the field of personnel administration. The transition from the scientific management movement to the industrial psychology movement has caused fundamental changes in the philosophy of personnel administration. These changes have significantly modified management's attitudes concerning selection, and fatigue of workers. However, management thoughts on financial and non-financial incentives have not been significantly modified.

An analysis is made of a large number of opinion surveys of workers, managers, and union leaders in an effort to determine the motivational factors needed most by workers from the point of view of workers themselves, managers, and union leaders. A comparison of the opinions of these three groups is made to determine the causes of industrial disputes and to determine areas of misunderstanding between these groups.

It is found that there is a difference between what workers want most, and what management and union leaders think workers want most from their jobs.

At the top of the list of workers' wants are higher wages and greater employment security. They want them equally. Following these two motivational factors are: recognition, interest, supervision, advancement, working companions, working conditions, working hours, and benefits.

On the other hand, managers still believe that workers want wages more than any other motivational factor including employment security which they ranked third in importance. In this respect management thinking has not changed from that of the classical school of management developed by Taylor and his colleagues. Also union leaders did not understand the importance of employment security to workers when they ranked it second to wages.

Therefore, there is a lack of correlation between the opinions of workers, management, and union leaders concerning the relative importance of financial and non-financial incentives to workers. However, management seems to have better sense of workers opinions concerning other motivational factors than union leaders.

In general, it is misleading to list incentives in the order of their importance. The particular incentives motivating an individual within a group of individuals are so different that only sweeping generalizations can be made. At the present time financial and non-financial incentives are of equal importance in motivating employees in the long run. However, in the short run the relative importance of the different motivational factors differs from one time to another and depends upon the immediate needs of the individual, as well as the general economic conditions of the industry and the country.

Neither financial nor non-financial incentives are sufficient within themselves to achieve optimum results in obtaining high morale and harmonious labor relations. The problem is not one of supplying economic or non-economic incentives; rather it is one of determining specifically how to fit both types of incentives effectively into an overall personnel program in order to produce the greatest degree of sustained effort on the part of employees.

Microfilm $3.35; Xerox $11.40. 259 pages.

INVESTMENT EXPERIENCES OF TWENTY-FIVE SELECTED FIRE INSURANCE COMPANIES, 1927 TO 1955.

(L. C. Card No. Mic 59-4809)

Easo John, Ph.D.
Northwestern University, 1959

The purpose of this study was to relate the differences in portfolio composition among the twenty-five selected fire insurance companies to the differences in their investment performance.

The portfolio composition of these companies was examined in regard to the proportions of major categories of investment media, common stocks, subsidiary stocks, preferred stocks, bonds, mortgages and cash holdings. It was found that there were very wide differences between companies. In addition it was also found that the proportions tended to be flexible over time and responsive to relative changes in yields from the different categories of investments.

Four different criteria were used for measuring investment performance. These were, the level of yield on total investments, the relative stability of yields, the extent of fluctuation in the market value of investments over the entire period and the stability in the market value of investments over shorter periods of time.

The overall changes in the proportions of different types of investments as well as in yields and relative changes in market value were measured using the median, the two quartiles and the highest and lowest values as representative measures. The inter-quartile range and total range were used as measures of dispersion. The level of yield for each company over the entire period, however, was measured by a simple arithmetic average of annual yields. Standard deviations from each average yields were used as measures of relative stability of yield.

On the basis of the first criteria, that of yield on investments, it was found that there were substantial and consistent differences between companies irrespective of whether yield was related to cost or market value of investments. These differences were found to be significantly associated with the proportion of common stock holdings (at cost) except for the period 1927 to 1935. However, when the portfolios of selected companies which showed consistent high and low yield characteristics were examined in greater detail, it was found that among the high yield companies there was one which was a high bond investor. Further, it was also found that the high yield companies held substantial proportions of subsidiary stocks. The income from such holdings formed a high proportion of total income of the companies. The low yield companies, on the other hand, did not have subsidiary holdings, or if they did, the income from such holdings was relatively small and irregular.

The second criteria, the stability in yields, did not reveal any marked differences between the high and low yield groups of companies.

Fluctuation in the market value of investments over the entire period was measured by both the annual average per cent of appreciation and the ratio of market value to cost of investments. There were wide differences between companies on the basis of both measures. The relationship between annual average per cent of appreciation and the proportion of common stock holdings was not found to be particularly high. The companies which ranked high in regard to average per cent of appreciation were also high common stock investors on the average. However, other companies which were high common stock investors did not rank high in regard to average annual per cent of appreciation. Investments in subsidiary stocks and the actual timing of common stock purchases appeared to be important factors in particular cases.

Fluctuations in market value of investments overshorter periods of time showed that the bond companies had the advantage of greater stability during the first half of the period. The overall magnitude of such fluctuations were found to have been considerably greater during the first half of the period studied.

The extent to which companies shift between categories of investments and turnover their holdings of common and preferred stocks was also examined. It was found that there were wide variations in the extent to which there was actual turnover. Considerable differences were also noticed in the volume and timing of shifts from common stocks to bonds or vice versa over the period.

Microfilm $5.25; Xerox $18.60. 412 pages.

STATISTICAL INVESTIGATION IN THE ELASTICITIES OF DEMAND FOR MOTOR FUEL, UNITED STATES, 1929-57.

(L. C. Card No. Mic 59-6717)

Eunice Kitchell, Ph.D.
The University of Texas, 1959

Supervisor: Dr. John R. Stockton

This study tested the hypothesis that the elasticity of demand for motor fuel, within known or ordinary price ranges, in the United States is low. The statistical laws of demand for motor fuel were derived by the method of least squares regression analysis from the trend ratios of time series of the per motor vehicle consumption of motor fuel, the retail real price of motor fuel, and the per capita real income for the period from 1929 through 1957. The coefficients of elasticity determined from the demand functions for each of the years from 1929 through 1957 were (1) price elasticity, (2) income elasticity, (3) partial price elasticity when income was held constant or equal statistically and consumption and price allowed to vary, and (4) partial income elasticity when price was held constant or equal statistically and consumption and income allowed to vary.

From 1929 through 1957 the coefficient of the partial price elasticity of demand varied from -.021 to -.035; the coefficient of the partial income elasticity of demand varied from .078 to .143. In all analyses of the data, adjusted for trend or completely unadjusted for trend, the regression of consumption on price was negative and that of consumption on income positive. The results of the study supported the hypothesis that the elasticity of demand for motor fuel, within known or ordinary price ranges, is low.

Microfilm $2.50; Xerox $4.00. 75 pages.

AN ANALYSIS OF EFFORT-OUTPUT RELATIONSHIPS IN HAND MOTIONS

(L. C. Card No. Mic 59-5564)

Richard Ivor Levin, Ph.D.
The University of North Carolina, 1959

Supervisor: John Dykstra

Most time study practitioners expect increases in effort by workers under an incentive wage payment plan to net them exactly proportional increases in pay. This assumes that increases in effort generate exactly proportional increases in output, true only when output is a direct function of effort, as follows:

$$\text{Output} = f\ (\text{Effort})$$

If output is not directly proportional to effort, the relationship is more correctly represented as follows:

$$\text{Output} = f\ (\text{Effort})\ (R)$$

where R is the relationship between the effort expended by the operator and the time required to perform a motion, or series of motions.

Five operators, three male and two female, were taught a simple job, consisting of five MTM motions. A movie film was made of each of them performing this job at eleven outputs ranging from 48% of normal up to and including 144.0% of normal. The films were analysed and the times required by each of the operators to complete each of the five motions at all eleven outputs were recorded. By employing the Methods Time Measurement published normal time as a standard, the relative effort level demonstrated by each operator on each motion at the output levels was calculated as follows:

$$\frac{\text{MTM published normal time}}{\text{operator's actual time}} = \text{effort displayed}$$

The effort levels thus obtained were displayed in graphic form, by charting them against the actual outputs achieved. Thus, the resulting curve represents R, or the relationship between output achieved and effort exhibited by each operator. A curve was thus generated for each operator for each of the five motions comprising the job. Results indicate that the smaller type of motions (Grasp, Release and Position) do not respond well to increased effort on the part of the operator, while longer motions (Move and Reach) respond favorably to increased effort on the part of the operator. The motion of Reach exhibits an R relationship, indicating almost direct proportionality between effort and output.

A composite curve, including all data from the five operators, indicates that output and effort for the entire work cycle were not directly proportional to each other but, rather, that more effort proportionally was required to achieve greater output. For example, at 125.2% of normal output, the operators collectively exhibited 126.6% of normal effort. Microfilm $2.50; Xerox $8.20. 176 pages.

A CRITICAL ANALYSIS AND APPRAISAL OF THE THEORY AND TECHNIQUES OF THE MANAGEMENT AUDIT

(L. C. Card No. Mic 59-6721)

George Guy Miller, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Joseph K. Bailey

This study strongly advocates that the Management Audit should be concerned with appraising managerial effectiveness in terms of the principles underlying the basic functions of management rather than with comparative analyses of operational data. To this end the distinction between business and managerial functions is emphasized, and a MANAGEMENT AUDIT GUIDE which incorporates a GENERAL AUDIT GUIDE and a MANAGEMENT FUNCTIONS QUESTIONNAIRE is recommended as a valid and satisfactory means by which analysts of greatly differing experiences may appraise management performance.

A GENERAL AUDIT GUIDE is presented as an outline for guiding the progress of an audit through the successive stages of audit assignment, collection and analysis of data, and final reporting. A MANAGEMENT FUNCTIONS QUESTIONNAIRE is presented as an outline for guiding the appraisal of managerial performance in terms of the generally accepted principles underlying the basic managerial

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

functions of Planning, Organizing, Directing, and Controlling.

The MANAGEMENT AUDIT GUIDE is not presented as a check list. It is recommended as a guide to aid analysts in systematically solving their problems by means of scientific methodology and as a guide to aid analysts in devising their own outlines for reviewing the vital check points which are the core of management auditing.

Thus, the MANAGEMENT AUDIT GUIDE is presented as a tool to be used as an aid in discovering and explaining managerial weaknesses in the application of the principles of management.

Microfilm $4.70; Xerox $15.80. 367 pages.

DEVELOPMENT AND INFLUENCE OF THE UNITED STATES RAW COTTON POLICY ON ITS ECONOMY

(L. C. Card No. Mic 59-6725)

Fouad Abdelaziz Tawfik, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Aaron H. Chute

Low income and instability of income have long standing recognition as the dominant problems of any agricultural economy including the United States. These problems are direct results of the weaknesses inherent in agriculture, the main characteristic of which is dependent on nature. The incompatibility of agriculture and industry, mechanization of agriculture, the nature of demand for and supply of agriculture products, and the business cycle significantly add to the congenital weaknesses of agriculture. Under such conditions the United States government undertook the responsibility of helping agriculture. In fact, giving aid to agriculture and industry of the United States is a policy of long standing since the 1920's. But the tremendous upsurge in scientific and technological developments, especially as they applied to agriculture in the United States, was new. Therefore, the government in its efforts to maintain the "status quo" of the old order in terms of price parity found itself in conflict with these new developments in the United States and world agriculture.

The outbreak of World War II made the United States feel the need for, and importance of, the plethora of raw materials. It realized the ill effects of a policy of scarcity based on acreage curtailment and marketing quotas. Therefore, it deserted such a policy for a policy of abundance. Acreage allotments and marketing quotas were discontinued for 1943 through 1949 and support prices were raised. Curiously, the same policy of restrictions was resumed after the War.

The United States raw cotton policy has adversely affected the national economy. In the first place, in spite of its costs the policy has not solved in any way low income problems of small farmers on poor hilly lands. Some of these farmers have come to accept government payments for not growing cotton as a form of social security. Others have decided to grow cotton on their allotted acreage, which meant that small inefficient, high-cost farmers, chained to poverty, would get allotments and produce cotton, and low-cost efficient large mechanized farm operations would be limited. In the second place, contraction of cotton production forced a parallel contraction of many businesses related to cotton such as ginning, cottonseed crushing, manufacturing, transportation, warehouses and compressing. Furthermore, cotton trade has been badly crippled in merchandising United States cotton in world markets. Moreover, the mounting costs to the government and people have become of growing concern.

The support price programs caused United States cotton prices to be higher than world prices. This situation encouraged both cotton producing countries and producers of man-made fibers to expand their production. The results have included the loss of markets for United States cotton and the intensification of cotton surplus accumulation. Therefore, several programs have been adopted to regain markets and dispose of surplus, such as sales for foreign currency, foreign relief, set-aside, subsidized export sales, and payment-in-kind programs. The purpose of these programs was to maintain export markets. Government subsidized exports contradict sound principles of international trade as well as American tradition and are opposed by other cotton exporting countries.

Therefore, a sound policy for production, pricing, marketing and consumption of United States cotton is proposed. It is based on recognition of the improvements in science and technology, as well as on the sound concepts of a free economic system. Acreage controls are to be dropped, as are marketing quotas, above-market price supports and export subsidies. Cotton prices are to be determined in free markets on competitive basis. Research and promotion are emphasized to stimulate consumption.

Microfilm $4.65; Xerox $15.60. 361 pages.

FEDERAL TAXATION OF LIFE INSURANCE COMPANIES: THE SAVINGS INSTITUTION APPROACH.

(L. C. Card No. Mic 59-6322)

Raymond Francis Valenti, Ph.D.
Syracuse University, 1959

Supervisor: Jesse Burkhead

Taxation of life insurance companies for income tax purposes has long been an unsettled area of the federal revenue system. An early experiment with the application of comprehensive definitions of income and expenses to life insurance companies was abandoned in 1921 after eight years of controversy and litigation. Since that time the industry has been taxed under several versions of the investment income theory which, in essence, taxes only upon that portion of investment income not required for policy reserves. Consequently from 1921 until the present, premiums and capital gains have been excluded from the tax base; neither have general business expenses been allowed as deductions.

Unfortunately, laws based upon the investment income concept have proven to be inflexible; as a result frequent rewriting of the statutes has been necessary either (1) to correct intra-industry inequities or (2) to bolster yield which has diminished at times despite continuous growth

in the industry. Each revision has ultimately developed deficiencies which have led, in turn, to further revisions. Congress has explored the issues in committee hearings eight times since 1913; nevertheless, the historic dissatisfaction persist—no satisfactory tax formula has as yet emerged. "Stop-gap" laws have been in effect since 1950 as the industry and the Treasury have sought to devise an acceptable permanent formula. The Treasury endorses as permanent legislation some form of the total income approach of the 1913-21 period; the industry, however, continues its traditional support for the investment income method.

Conceptual and administrative limitations weaken both the total income and investment methods as acceptable techniques for measuring taxable income of life insurance companies. These inadequacies develop primarily from certain distinctive aspects of life insurance which create areas of controversy. The major conflict areas revolve about (1) the dual nature of life companies as protection-selling businesses and institutions of deposit, (2) difficulties involved in determining underwriting gains and losses on a year-to-year basis, (3) competitive issues arising from the mutual-stock division within the industry. This paper rejects the traditional approaches as useful measures for resolving these issues. This rejection has led to the formulation of the "savings institution" approach —centralized about the theory that the proper method of taxation must proceed from the savings-institution characteristics of life insurance companies. Basically this system permits the underwriting function to be exercised without tax consequence contending that tax laws should not penalize this unique and socially desirable contribution of insurance. However to the extent that insurance companies operate as savings institutions, taxes would be imposed in a manner substantially similar to other savings institutions—notably mutual savings banks and savings and loan association. Moreover, the individual who elects to save in one—rather than another—of these institutions would also be accorded equal tax treatment.

Following guideposts established for taxing savings banks and savings associations, life insurance companies would (1) report to policyholders the interest element in the annual increment in the cash value of policies; this interest would be taxable income to policyholders; (2) be permitted to create a tax-free contingency reserve equal to 10 percent of statutory policy reserves; (3) pay taxes at corporate rates on profits retained in excess of this reserve. Formally, stock and mutual insurers would be taxed alike; effectively, stock insurers would be taxed more severely. Reporting would conform essentially to the industry-wide uniform accounting system established by the state insurance departments. Consequently, all income—premiums, investment income, and net capital gains—would be included in the tax base and all operating expenses, reserve interest requirements, and policyholder dividends would be deducted before deriving net operating gain. Several minor modifications are also proposed based upon considerations of equity and administrative simplicity.

Microfilm $4.15; Xerox $14.00. 322 pages.

AN INVESTIGATION OF THE SOURCES OF LONG-TERM CAPITAL FOR SMALL BUSINESSES (WITH EMPHASIS UPON THE SOURCES UTILIZED BY SMALL BUSINESSES IN COLUMBUS, OHIO).

(L. C. Card No. Mic 59-6656)

James Edward Wert, Ph.D.
The Ohio State University, 1954

The Objectives

The objectives of the study are twofold: (1) to make available a digest of the alternative sources of long-term capital; and (2) to make available data regarding the personal characteristics of a typical promoter, several nonmonetary decisions required of all promoters, and the sources of long-term capital that were actually utilized.

Sources of the Data

The data were derived from secondary sources, primarily found in the Survey of Current Business, and from a primary survey consisting of personal interviews with thirty-three officers of selected small businesses in Columbus, Ohio, that were incorporated during 1953.

Definition of Terms

Two definitions are very pertinent to this study. They are: (1) small business, and (2) long-term capital. A "small business" is one that has fewer than fifty employees, if it is a manufacturing firm; or total assets of not over $100,000, if it is a nonmanufacturing firm. Furthermore, the enterprise must operate on a local basis and be dependent, more or less, upon local sources for its funds. "Long-term" capital is defined as equity capital, and debt instruments having over five years' maturity.

Need for Long-term Capital

A few decades ago the so-called small business of today would have been considered a big business, at least in many lines of endeavor. Costs have mounted, thus increasing the capital needs of going businesses and the capital required to start businesses. The rise in the price level has about doubled the amount of capital required since 1939; but that is responsible for only a part of the new needs for long-term capital. It costs much more to go into business today than it did before World War II. In 1945-47 the Office of Business Economics of the Department of Commerce made a study of one thousand recently-organized retail and wholesale establishments to ascertain the average initial investment. For wholesalers, the average initial investment was found to be $22,000, which was approximately double the prewar average. For retailers the average was $9,500, but with wide variations among the different lines of activity. For retailers handling building materials, hardware and farm implements, for example, the average initial investment was $25,000; for retail distributors of motor vehicles, $14,000; for apparel stores, $9,700; for retailers of furniture and house furnishings, $9,700; for retailers of household applicances, $7,000; and for gasoline filling stations, $5,600.[1]

Financial Characteristics of the New Firm

The financial pattern of new firms is surprisingly simple--consisting ordinarily of 250 shares of common stock outstanding. However, there were promissory notes present in over 50 per cent of the cases. As a rule, it was

much more difficult to finance a manufacturing firm than a wholesaling or a retailing enterprise. Therefore, the owners of the manufacturing enterprises contributed 91 per cent of the total long-term funds as compared with 85 per cent and 76 per cent for the wholesaling and retailing businesses, respectively. The difference in the latter percentages from those of the manufacturing firms exists because of the more liberal long-term credit granted by other business firms. Usually, however, there was a nonmonetary cost involved in the use of this latter source of funds. Thus it is seen that much of the initial financing of new business enterprises is derived from the savings of the entrepreneurs. It is equally true that most of the funds necessary for future expansion will be obtained from retained earnings and depreciation reserves of the corporation. Increases in personal and corporate income taxes accompanied by increases in costs have made it more difficult for small businesses to acquire sufficient capital from these sources. Also, dependence upon local conditions and lack of product diversification make small enterprises susceptible to extremely wide variations in profits and losses. Thus, savings and reinvested earnings, in many cases, are inadequate for the promotion and growth of small businesses.

In many instances it might be desirable to supplement the entrepreneurs' investments with external financing. Small firms have been handicapped in their efforts to procure long-term capital from outside sources. The costs of marketing small stock issues are prohibitive. There is no market for such issues. Rather than invest in small unknown firms, the normal investor prefers equities of larger corporations. While community industrial development groups have participated in equity and long-term debt financing, their contributions up to the present have not been very extensive.

The inability to raise equity capital has created a demand for long-term loans. Costs are high and the market thin; thus debt financing on the open market is discouraged. With the possible exception of wholesalers, the businessmen stated that bank credit was too "tight" even for short-term loans. Term loans were virtually unavailable for all types of firms; the maturities of those that were granted were less than five years. This is the case because banks are not in a position to grant long-term credit. Banks are themselves often small businesses and do not have adequate resources to permit diversification of risks. In addition, they are high leverage organizations. Furthermore, the cost of servicing small long-term loans would be extremely high.

At present the Small Business Administration is the only government institution actively leading to small businesses. This agency is the successor of the Reconstruction Finance Corporation, the latter dating back to 1932. In the past few months the SBA has liberalized its credit standards, and, therefore, should play a larger role in small business financing in the immediate future. The RFC and the SBA have attempted to promote a credit relationships between bank and business by emphasizing bank participation loans. The businessmen objected to the SBA's emphasis on this procedure. They felt the whole process was too cumbersome. In addition, they have considerable pride and do not like to re-approach any bank that has previously rejected them on their original application for a loan in order to secure an SBA-bank participation loan.

The adopted financial plans suffered from three weaknesses: (1) the "thin" corporation retarded subsequent financing; (2) overemphasis on short-term credit was typical; and, (3) the failure to raise sufficient long-term capital to launch the business properly caused early financial worries. Therefore, in the majority of cases subsequent personal contributions were required of the owners. External sources were totally lacking; hence, all these contributions were made by the owners. Thus it was harder to raise additional money after the business had just been launched than to interest outside capital in a wholly new enterprise. This occurs because the exhaustion of funds before the firm is on its feet raises the presumption that there is something wrong with the enterprise or with management.

The plan adopted in each case was the result of the interplay of numerous forces. Basically, there is a shortage of long-term funds, and the financial plan of each corporation show evidences of attempts to combat this shortage. However, the methods used to combat it even if successful would be merely temporary, and in many cases are actually detrimental to the long-run interests of the corporation.

Several Characteristics of the Entrepreneurs

By and large, businesses are started by persons of mature age with considerable business experience. It is unlikely that many young people possess, or are able to borrow, sufficient capital to start a business. Furthermore, each man interviewed stressed the importance of having previous business experience before attempting to establish a new business. The average age of the thirty-three promoters was forty, and they generally had a good education—over 50 per cent being college graduates. All but two of the promoters were married. Over two-thirds of the promoters had previous experience in a similar type of business; however, approximately one-half of this group had no experience in unrelated fields. The remaining one-third of the thirty-three promoters who did not have related experience, generally had extensive experience in other areas to compensate for the lack of experience in the type of business that they now managed. There is a definite inverse relationship between the amount of related to unrelated experience.

For seventeen of the thirty-three promoters, or 50 per cent, the present businesses represent their first ventures. As a rule, the balance of the thirty-three generally held minority interests in previous businesses, and the present firm represented their first controlling interest in a business.

The reasons for establishing a business are varied. One that predominated involved salesmen who had secured valuable exclusive sales areas or contracts for special orders. Other important reasons were the desire to exercise an option to purchase, and the desire to exploit a known demand discovered while employed in a former occupation. It can be seen that the very nature of these factors made it necessary to incorporate only after a rather brief deliberation.

In the case of firms headed by nonresidents of Columbus, the advantageous location of the city in regard to their sales area was the usual deciding factor. The demand for industrial space was characterized by emphasis on cost; for wholesaling space the important consideration was location, and for retailing space a site in a shopping center

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

was usually desired. Concerning the prospective market for their goods and services, reliance was placed primarily upon vague general impressions. Perhaps this is to be expected since the services of good market analysts are both expensive and scarce, and practically all businessmen are untrained to make scientific market analyses on their own. Nevertheless, until this deficiency in consumer analysis is corrected, it is improbable that the high mortality rate of new businesses will be reduced substantially.

Proposals to Increase the Availability of Long-term Capital

Regardless of how much other sources may be encouraged and developed, the savings of the enterpriser must remain the basic source of risk capital for new firms. Then, once the firm begins operations its equity will probably be enlarged by plowing back earnings from successful operations. What the business can retain after taxes bears crucially on this problem. The trend of business taxation has made investment in smaller enterprises steadily less attractive, since the percentage of profits remaining to the small businessman after the payment of taxes is becoming nonproportional to the risk and effort involved. Generally speaking, any improvement in this area must come about by means of remedial legislation. Six specific recommendations to help encourage small business financing are suggested.

1. The Internal Revenue Code should be relaxed to permit small businesses to accumulate tax-free reserves out of earnings for reinvestment in the business. The simplest way to achieve this is to exempt the first $10,000 of corporate income from taxation if reinvested in the business. This would allow small businesses to retain earnings without penalty in case further expansion is planned. Also, a $10,000 exemption would be a move in the right direction of eliminating double taxation. Because of the several devices utilized to avoid this double taxation at present, such a proposal would help simplify balance sheets because such ruses would then be unnecessary, and as a result, some businesses might be more creditworthy.

2. Another recommendation for a change in the Internal Revenue Code deals with depreciation allowances. The tax system should permit accelerated depreciation within closely defined limits. Accelerated depreciation would be particularly important to new small firms because it would materially reduce their risks in connection with capital investment. As to the method of administering it, businesses should be permitted to switch their annual tax deductions for depreciation from a "straight line" to a "declining-balance" method at a rate sufficiently high to make the switch worthwhile.

3. The third suggestion also deals with the Code although it is not a recommendation for a change. A clarification of an existing section is needed. A number of promoters found Section 102 a matter of serious concern; they have complained that they do not know where they stand in respect to permissible investment policies. The misinterpretation of this section may force these firms to increase investments, inventories, or dividends with corresponding decreases in liquidity. The result may be that solvency has been endangered. Although the small closely-held corporation has been subject to the majority of the assessments under Section 102, the Treasury Department has many times stated officially that it is willing to allow ample room for retention of earnings for all reasonable and legitimate business needs. Thus, it is recommended that further clarification of the provision be made, and perhaps a minimum exemption should be permitted. Full information should be presented to the small business sector setting forth the standards by which violations will be determined.

4. The purpose of this recommendation is to stimulate term loans to small businesses. The best proposal, although it does require government participation, would seem to be the provision of loan insurance for bank loans to small businesses so as to protect banks against the nonliquid and nonmarketable character of small business assets and the added risks involved.

5. The SBA has already energetically undertaken the objective of rendering technical and managerial assistance to small businesses. There is a particular need for further research in analyzing markets. The SBA could very well investigate this field, and try to communicate its findings to an increased portion of the small business population.

6. From the study it must be concluded that the Federal Reserve Banks have not exercised to any appreciable extent their authority to make direct loans to small businesses. Therefore, it would seem that the program is so inactive presently as to warrant its immediate repeal. It is advisable that all direct government loans to small business be made through the SBA.

As a general rule, the writer believes that a program of government participation should be encouraged only after adequate solution to the problem cannot be found in the private sector of the economy. In the case of commercial bank term loans the writer believes there is no adequate solution without government assistance in the form of loan insurance. Inasmuch as the savings of the entrepreneur must remain the basic source of risk capital and the expansion of established firms must depend largely upon reinvested earnings and depreciation allowances, the Internal Revenue Code revisions are essential in any program designed to stimulate small business.

Microfilm $3.05; Xerox $10.40. 234 pages.

1. Foulke, Roy A. "The Outlook of Small Business," Banking (February, 1950), p. 33.

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THE DEVELOPMENT OF POLICIES AFFECTING THE MARKETING OPERATIONS OF THE JEWEL TEA COMPANY, INC., 1901-1951.

(L. C. Card No. Mic 59-6648)

John Sherman Wright, Ph.D.
The Ohio State University, 1954

The study can be described as a partial history of the Jewel Tea Company, Inc. for the years 1901-1951. Its scope is confined to the development of marketing policies during those years, although other phases of business management are considered when pertinent. Three major objectives are set forth: (1) to provide a business history of one marketing firm; (2) to trace and analyze the process of marketing policy formulation as performed by the management of one company; and, (3) to scrutinize the method

of operation used by the firm and the home-service industry of which it is the leader.

Little research and writing has been done in any of these areas. Marketing has been studied principally by means of the functional, institutional, and commodity approaches with only slight attention given to its historical aspects.[1] The whole field of business history is quite unbroken by the scholar's plow, especially in the case of distributive institutions. Furthermore, investigations of marketing policy formulation and the home-service industry are generally lacking.

The method of research adopted consisted of examining company records for the fifty-year period in order to ferret out information falling into these three categories. The minutes of board of directors' meetings and presidential reports to that body provided the core of basic data. This was supplemented by other company records and publications, interviews and correspondence with past and present executives of the firm, and periodical and newspaper articles.

The Jewel Tea Company, Inc. is a New York corporation with home offices located in Barrington, Illinois. The retailing of food, household, and general merchandise products constitutes its major function. These goods were sold in 1951 by means of more than two thousand home-service routes operating in forty-two states and the District of Columbia plus some one hundred fifty retail stores located in the Chicago area.[2] Emphasis has been placed upon the Routes Department with the Food Stores Department receiving attention only as it affected the operation of the routes phase of the business. Annual sales volume for the entire company exceeded two hundred million dollars in 1951.[2]

The home-service industry has a highly stylized method of operation. Housewives are contacted by solicitors, called "advance salesmen," who persuade them to become customers of the company. This is accomplished by a salestalk which features a premium offer and the quality of the products sold. The orders taken are delivered by a route manager who services a group of ten different sets of customers once every two weeks in order to fill their needs for coffee, tea, spices, soap, flavorings, and other merchandise.

The industry employs a method of operation which is actually a refinement and adaptation of the peddling technique. Approximately 8,700 routes were being operated by all members of the industry in 1951 with total sales approaching $200,000,000.[3] Nearly one-fourth of these routes were owned by the Jewel Tea Company which accounted for three-eighths of industry sales volume.[3]

The company's history contains five distinct periods. The first was one of inception followed by fast growth. Frank Skiff and Frank Ross started the company as a partnership which owned one horse and one wagon; by 1916 the number of units had risen to 850. In that year the present company was incorporated in New York, and the second period was started with an accelerated rate of expansion. By the end of 1917 more than 1,700 routes were in operation; however, the conditions surrounding the business during wartime soon brought financial disaster. A period of re-entrenchment was begun in the middle of 1919 under the leadership of John Hancock, who brought control measures to the company. In 1924 he was succeeded by Maurice Karker, his lieutenant. This fourth period lasted until 1942 and was characterized by steady, cautious growth. Franklin J. Lunding brought the company through World War II and introduced a new philosophy of merchandising into the routes phase of the business. Each of these men made contributions to the growth of the firm and were responsible for the adoption of important marketing policies.

The partner-founders had policy formulation decisions to make from the beginning. A method of operation had already been developed by their predecessors in the industry; whether its adoption in toto was advisable had to be determined. They chose the fortnightly delivery pattern in order to obtain a more extensive cultivation of the market with a limited capital fund. Although weekly deliveries were tried later on an experimental basis, the intuitive selection of the founders has remained in force.

Premium merchandising is at the very heart of the home-service method of operation and is an important characteristic distinguishing it from most other forms of retailing. Customers are given various items of general merchandise as a form of patronage dividend in order to interest the prospective customer and to retain patronage after the first premium is earned. This technique was adopted by Skiff and Ross without question; however, their employment of the policy was sophisticated. The customer was given the premium prior to buying the merchandise necessary to bring about its redemption, whereas other companies required the accumulation of checks until a quantity sufficient to earn the premium had been collected. This policy was formulated on the spur-of-the-moment one day when Frank Ross was attempting to meet a customer objection to the premium merchandising principle. The decision was purely opportunistic, yet became, probably, the most important factor in the company's success.

The use of advance salesmen was also adopted at the beginning of company operations, although many efforts have been made to eliminate them and shift their function to the route managers. Nevertheless, the need for their specialized talents, even though expensive, has brought about their continuance.

The company traditionally followed a policy of pricing that would yield relatively high gross margins. They are necessary, for the method of selling is expensive because of the high labor charges incident to the services of delivery and personal selling. Following World War II it was decided that margins should be shortened in order to make prices more competitive with other retail outlets, thereby increasing profits via the route of increased sales volume albeit at lower per unit rates. Full application of the policy has not been achieved. It resulted from a deliberate search for a way by which the company could expand other than through the addition of more routes.

Other ways of achieving increased sales volume have been adopted. In 1951 a policy of mail-order selling became part of the method of operation. Many general merchandise items are sold from a catalog with orders solicited by route managers, and the goods shipped from the home office via parcel post. Positive thinking and planning were involved, as well as the technique of adaptation.

Company operations are divided into seventy-one branches. In the hands of the branch manager rests the responsibility for management of the sales force, the route managers. To a large degree, the recruitment, selection, and training of these men is done on a decentralized basis by the branch manager. The compensation and stimulation facets of sales management, however, are centralized. Route managers are paid under a commission plan which

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is company wide in application; earnings are tied with individual production of sales. Sales contests are used as an additional means of route manager stimulation.

Sales management policies affecting route operations, rather than the activities of the route manager, are increasingly centralized in the hands of home office personnel. New routes are added after a close scrutiny which includes not only the merits of the proposal but the overall expansion plans of the company. Provision of branch and route equipment and facilities is carefully regulated. Sales quotas, expressed in dollars of sales per route per week, are established centrally.

Except for two occasions, once following World War I and later in the mid-1930's, serious labor unrest has been absent from the company's management-labor relations history. In those instances unsuccessful attempts to unionize route managers were made. Skiff and Ross drove their employees to performance; Karker replaced this philosophy with one of paternalism. President Lunding introduced more enlightened policies with a philosophy of democratic leadership aimed at getting employees to produce because of a desire to produce.

The basic credit policy of the company is that sales are made for cash only. One exception, namely, that the route manager could extend credit for two weeks, was made advisable by the method of operation. Often housewives are either temporarily out of funds or not at home at the time of the route manager's call; a strict cash policy would necessitate loss of the sale. The basic policy was formulated to minimize credit losses; the exception came in answer to a pressing operational problem which it occasioned.

Following World War II, a rather sharp deviation was made from the no-credit policy. At this time instalment credit was introduced for general merchandise items of relatively high value. The reason for the change in policy was similar to that for the introduction of mail-order selling, that is, in order to permit the extension of the company's product line thereby increasing sales volume possibilities. The Jewel Tea Company had experimented with the instalment credit idea earlier, only to abandon it. Later, competitors adopted it with success, and the company readopted the technique. The company was first an innovator and then a follower.

Most of the food items and many of the household supplies sold through the routes operation are manufactured, processed, and packaged in company plants. The founders soon saw the possibilities in this form of integration; within five years goods were coming from company plants. The policy originated in the search for greater profits; it has been adapted to include quality control and more competitive pricing among its objectives.

The principal item in the product line has always been coffee. At one time more than three-fourths of all sales dollars were derived from coffee sales; this ratio has declined to around one-third. It is highly important that coffee be promoted by route managers since it furnishes an excellent means of insuring regular patronage. The customer with a standing order for coffee delivery every two weeks remains on the route customer list longer and buys more merchandise than other customer. At first merely a policy which recognized an existing condition, the primacy of coffee in the produce line came to be part of a considered plan of merchandising aimed at retaining customers.

In the latter half of the 1920's two bold experiments were made. One was an attempt to wholesale coffee to retailers in Brooklyn and Hartford. The policy was formulated as a way of increasing profits through fuller utilization of plant capacity, and more importantly, because of the fear that the home-service method of selling was obsolete and alternative methods of operation should be developed. The idea failed completely.

The other experiment was an extensive advertising program carried on in the state of Ohio. It was used in an attempt to reduce the costs of personal solicitation of new business by acquainting prospective customers with the home-service method of selling. Costs were not lowered and the plan was abandoned. It had long been claimed that the premium was the company's method of advertising. This claim is merely a subterfuge and came about mostly as a rationalization for another policy, i.e., the policy of premium merchandising. It furnishes an answer, of sorts, to the customer objection that the premium is paid for in the price of merchandise bought from the company. Advertising, as the term is commonly used, is little used by the Jewel Tea Company in its routes operation.

The company entered upon a diversification project of importance in 1932 when a chain of grocery stores located in Chicago was purchased. These stores have been operated since then as an independent part of the Jewel Tea Company. The chain store policy had been long contemplated, mainly because of the ever present fear that the home-service method of selling was becoming outmoded. The decision had far-reaching effects upon the Routes Department of the company. In addition to appreciable contributions to company sales volume and earnings, the Food Stores Department has furnished a healthy intra-company competition among members of the executive force and a new outllook on merchandising philosophy.

The changing character of marketing operations over a period of years has been traced through an examination of the policies of one marketing firm. The home-service method of operation taken in its totality was much the same at the end of the period as at the beginning, yet fundamental variations had been tried and occasionally grafted upon it permanently.

Policy formulation techniques used by the company leaders underwent an important maturing process. The founding partners met their problems by means of such unsophisticated devices as intuition, opportunism, and expediency. Their immediate successors found these methods insufficient in the business environment surrounding them and added caution, reflection, and scientific business management to the picture. During the last ten years an attempt was made to fuse the imaginative approach of the founders with the cautiousness of the men who followed them. As late as 1951, however, an established procedure of policy formulation had not been developed.

The tenacity of established methods of operation in the struggle among competing manners of reaching for consumer dollars is illustrated by the home-service industry. Although a direct descendant of the most ancient form of retailing, peddling, and often under fire as an uneconomical means of distribution, it not only survives but thrives. The axiom that institutions continue to flourish as long as they perform a service to their customers is proved by this case study.

Microfilm $3.30; Xerox $11.20. 253 pages.

1. Maynard, H. H., and Beckman, T. N. Principles of Marketing, 5th Ed. New York: The Ronald Press Co., 1952, pp. 16-18.

2. Annual Report 1951. Barrington, Illinois: Jewel Tea Company, Inc., 1952, p. 2.

3. Interview with Oliver J. Corbett, Secretary-Manager, National Retail Tea and Coffee Merchants Association, March, 1952.

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THE ECONOMIC ASPECTS OF THE CALIFORNIA LIQUEFIED PETROLEUM GAS INDUSTRY

(L. C. Card No. Mic 59-4419)

William David Wubben, Ph.D.
The Claremont Graduate School, 1958

This industry study deals with the production, demand, and marketing of liquefied petroleum gas (butane and propane, collectively known as ("LP-Gases"); and with those factors which determine both the prices and the amounts demanded and supplied at the producer's and consumer's level.

The facts on which this study is based were obtained (a) from interviews with executives of producing and marketing companies and with others who are active in the LP-Gas industry or related industries, and (b) from government and trade association statistics on LP-Gas production and the factors which influence LP-Gas demand and supply.

The most important findings of the study are:

1. Butanes are now used mainly for gasoline, in which they have a greater value than can generally be obtained from the LP-Gas industry.

2. A given amount of propane is produced as a by-product in petroleum refinery and processing operations. This propane is not as yet valuable in gasoline manufacture, and therefore is sold directly for the most advantageous price that can be obtained. Independent LP-Gas marketers purchase this propane and distribute it to the final consumer.

3. The principal use for propane which has been developed is as a heat fuel, but when so used the return obtained is much less than that received for mechanical energy fuels (such as gasoline).

4. Many producers anticipate that, with advances in technology, ways will be found to use propane in making gasoline, and consequently do not regard the LP-Gas industry as offering the best market for propane in the long run. In such cases the producer is merely "marking time" by selling propane to the LP-Gas industry until the anticipated more advantageous use develops.

5. The most important factor determining the demand for LP-Gas is the weather. Demand increases with colder weather and this makes for a marked seasonal pattern of demand. Price and personal income of consumers have very little influence on demand.

6. Producers fix a price for propane which will enable them to dispose of all that can be produced for the highest return during periods of maximum demand. It is because the price so established is low enough to encourage the use of propane for space heating that the seasonal fluctuation noted above occurs. During the summer season, when the amount demanded is low, the surplus propane produced is diverted away from the LP-Gas trade by the producers, and the price (apart from minor seasonal adjustments) is maintained. There is thus considerable elasticity of propane supply which results in the adjustment of the amount supplied to the amount demanded.

7. In the LP-Gas industry a specialized group of marketers has developed to handle the complex and unique problems involved in marketing the produce to the final consumer. In recent years there has been a marked expansion in the scale of operations of some of the larger of these marketers, until they are now in a position to bring considerable bargaining pressure to bear upon the producer in the pricing of LP-Gas. To a large degree, this development has occurred because the producer is unwilling to enter the LP-Gas industry as a marketer (in contrast to his marketing activities with respect to gasoline); and such unwillingness is probably due to the belief that the most advantageous future use of propane will be for gasoline manufacture.

8. At the retail level the "produce" sold is actually a combination of product (LP-Gas) and services rendered, and variations in retail prices will in part depend on the extent of the services rendered.

9. The LP-Gas industry is now fully established and the future will likely see a continued growth in importance of the large scale marketer.

Microfilm $7.30; Xerox $25.00. 575 pages.

COMPANY SPONSORED TRAINING PROGRAMS FOR CORRESPONDENCE IMPROVEMENT--STATUS, METHODS, AND ACHIEVEMENTS.

(L. C. Card No. Mic 59-6662)

George Henry Zeiss, Jr., Ph.D.
The Ohio State University, 1954

Nature, Objectives, and Scope of the Study

The study is concerned with the way the individual business firm can most effectively improve the quality of its business letters. The primary objectives of the study are:

1. To demonstrate that properly conceived training for letter improvement within a firm will generally result in more effective letters being produced

2. To determine the guiding principles and methods for developing such training programs

In addition, the writer sought to accomplish the following subsidiary objectives:

1. To synthesize management theory and business correspondence principles so that more effective correspondence training programs can be developed

2. To bring a more objective and scientific methodology into the analysis of business correspondence problems

The study thus includes only that area having to do with company-sponsored training activities to promote better letters. It does not deal with principles of business correspondence as such. Nor does it include those related

office activities that help to promote improved correspondence. Chief emphasis is placed on training for dictators, who are primarily accountable for turning out the business letters of a firm.

Approach, Sources of Data, and Limitations

The problem has been studied chiefly through two approaches: (1) a general analysis of the correspondence training programs of a sample of business concerns that have such programs, and (2) a specific and detailed analysis of the letter improvement program of the Farm Bureau Insurance Companies of Columbus, Ohio.

Data have been secured by three methods: (1) published works, (2) questionnaire surveys, correspondence, and personal interview, and (3) first-hand experience and experiments of the author in the Farm Bureau Insurance Companies. Because published literature on the subject is scant and inconclusive, chief emphasis is on data from primary sources.

The Need for Business Letter Improvement

It is not difficult to show that the correspondence of many firms needs substantial improvement. This need stems from two reasons: (1) the high cost of producing business letters, and (2) the ineffectiveness of much business correspondence.

Numerous studies have shown that, on the average, producing a dictated letter is likely to cost from seventy cents to one dollar. For example, a study made by the Dartnell Corporation of 232 companies revealed an average cost of 78.3 cents per letter.[1] A careful analysis in the Farm Bureau Insurance Companies showed an average letter cost of 89.4 cents, while a similar study in the Southwestern Life Insurance Company of Dallas, Texas, revealed an average cost of $1.25 per letter.

These costs would not be disturbing except for the fact that so many business letters do not yield a return commensurate with their cost. Many fail to accomplish their purpose, or, even worse, yield a negative return by alienating goodwill and losing business for the company. Among the faults commonly found in business letters are the following: (1) lack of clarity; (2) rambling, verbose style; (3) unnatural, stereotyped language; (4) negative, curt, tactless statements; (5) failure to achieve unity, coherence, and emphasis; (6) awkward, incorrect, or overly long sentences.

Because of these shortcomings, a number of undesirable effects are achieved while other desirable objectives are not attained. Among the more important of the undesirable effects are the following: (1) loss of goodwill; (2) loss of sales; (3) misunderstanding; (4) duplication of correspondence; (5) delay in accomplishing important missions; (6) increased costs of letter production.

Means for Improving Business Letters

In the long run the quality of business correspondence will doubtless be affected most by a higher level of formal education and literacy. Many concerns cannot rely solely on this method, however, because they have an immediate problem of substandard letters. Moreover, many people enter business from secondary schools where they often receive inadequate training in composition and perhaps none at all in business writing.

In lieu of formal education, self-study can and often does prove helpful. It is apt to be a slow process, however, and one which few people will adhere to long enough to produce notable results.

Since formal education is a long-time process and self-training an unreliable one, the only effective alternative for a concern with an immediate problem is to train its own letter writers.

Evidence of Success Achieved by Company Sponsored Programs

There is evidence to suggest that company sponsored training programs offer a practicable and effective means for improving the quality of a firm's letters.

1. Investigation of the letter improvement activities of the Farm Bureau Insurance Companies revealed that employees of the firm were convinced of the values derived from the training they had received over a period of several years. The types of training and percentages of respondents registering approval of them were as follows:
   a. Departmental clinics or discussion groups—75 per cent
   b. Correspondence bulletin—74 per cent
   c. Correspondence manual—78 per cent
   d. Letter-of-the-month contests—71 per cent
   e. Classes taught by the author—85 per cent
2. A statistically significant improvement in the quality of Farm Bureau letters resulted from a series of ten classes which the author conducted for 350 employees. Five before-training and five after-training letters from each of a sample of 100 trainees were carefully evaluated and scored on the characteristics of clearness, conciseness, construction, tone, and rhetoric. On the basis of the rating method used, an over-all improvement of about 17 per cent was achieved. Each of the eight departments supplying trainees showed improvement, ranging from a low of eight per cent to a high of 24 per cent. Improvement was noted for each of the five letter characteristics checked, ranging from 13 per cent for conciseness to 25 per cent for rhetoric.
3. A significant number of important companies have been and are at present carrying on such programs. For example, a Fortune magazine survey in 1950 revealed that one third of the nation's largest firms had training programs in business writing, including business letters.[2]
4. Surveys conducted by the author in 1950 and 1954 tended to substantiate the Fortune conclusion. In 1950, of 65 respondents from a selected list of 100, 66 per cent were conducting such programs. In 1954, of 83 respondents from a mailing list of 133, 48 per cent were carrying on training programs in business correspondence. (These figures are not representative of all major business firms because the mailing lists were made up of companies thought most likely to have letter improvement training.)
5. Of the concerns that have used correspondence training programs, a great majority (72 per cent) considered their programs successful. (None admitted failure, but 28 per cent reported that they did not know whether their programs had been successful.)
6. The respondent firms were able to point to a number of specific areas where their letters and the results therefrom had improved because of training. The most common indications of success mentioned were increased goodwill, more concise letters, fewer stilted or stereotyped expressions, fewer complaints about their letters,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

compliments on the excellence of their letters, fewer letters written to accomplish the same results as before, and better response to letters.

7. Among the nation's leading corporations the list of those that utilize letter improvement training is impressive. Examples of such firms are: Armco Steel Corporation, Caterpillar Tractor Company, American Tobacco Company, General Electric Company, General Foods Corporation, Goodyear Tire and Rubber Company, Marshall Field and Company, National Cash Register Company, Remington Rand, Inc., Prudential Insurance Company, New York Life Insurance Company, and Metropolitan Life Insurance Company.

Principles for Correspondence Training Programs

In foregoing pages it has been demonstrated that the letters of many business firms are in great need of improvement. It has also been shown that company sponsored training programs offer an immediate and effective means of improving the abilities of a firm's letter writers—and thereby of improving the effectiveness of its letters.

In order for these positive results to be achieved, however, such training programs must be soundly conceived and properly executed. In the following paragraphs, therefore, there will be outlined certain principles that can be used to guide the establishment and operation of a training program for letter improvement.

Principles Based on Management Theory[3]

1. Management must clearly understand the objectives that should be achieved through the firm's letters in order to judge whether or not its letters are fulfilling their important role as a management tool for communication. These letter objectives should in turn be used as the basis for determining the objectives of a training program.

2. A careful analysis of the nature and extent of the problem that exists with regard to the firm's letters must be made in order to shape the type of program that is to be presented—or even to determine whether a program is necessary at all.

3. A formalized correspondence training program can be handled most effectively as a technical staff activity. When the firm has even a training department or training specialists, delegation of the program to that staff group is indicated.

4. If a firm is to define its training objectives with some degree of exactness, it must set up standards of quality for its business letters. Unless management knows what constitutes an acceptable quality level, it cannot determine the extent of its correspondence problem nor can it know to what level of performance its employees should be trained.

Principles Related Directly to Training

1. The interest and support of top management is essential to the success of the program. That interest must be made apparent to those being trained.

2. A determination of the type of training needed should be made from a careful analysis of the letters being written by the firm's correspondents.

3. All training should be carefully planned in step-by-step detail before training is begun.[4]

4. The trainees must be properly motivated. It is especially important to show them why they should want to write improved letters

5. Trainee participation should be stimulated because the greater the participation of the learner the greater will be the speed of learning and the degree of retention.

6. Appropriate visual aids should be fully exploited since they promote speed of learning as well as retention. Examples of letters should be used profusely.

7. Training methods should be determined by objectives to be accomplished and the nature of the people to be trained.

Methods for Establishing and Operating A Training Program for Letter Improvement

In the following paragraphs the principles set down above will be translated into specific suggestions for beginning and carrying on a correspondence training program.

Surface Indications that a Problem Exists

If the firm has never sponsored training of any kind for its correspondents, it would be well to investigate the current quality of letters being mailed out. In addition, if any substantial proportion of those who dictate letters have little or no education beyond secondary school, there is a likelihood that a correspondence problem exists.

If salesmen, other field personnel, or customers complain of letters written to themselves or others, a serious correspondence problem may well exist. Finally, if there is any considerable turnover among the firm's correspondents, a fertile field for training is likely to exist.

Determining the Nature of the Problem

If it is suspected that a correspondence problem exists, a preliminary investigation should be made to confirm or deny the suspicion. Such an investigation can be made most simply by a review of carbon copies of a sample of outgoing letters. If it is found that the firm's letters measure up to a reasonable standard of excellence, the project may be discontinued at this point. If such is not the case, however, further analysis is indicated.

For the most part, this further and more thorough investigation will also center around carbon copies of outgoing letters. The analysis of carbon copies plus a classification of strengths and weaknesses so revealed will go far toward indicating the nature of the trouble and should suggest possible remedies.

In addition to common faults in letter composition, a thorough carbon copy analysis may also reveal improper grasp of the requirements of job assignments. Correction of such basic weaknesses must obviously be a concern of management but lies outside the scope of this study.

Training Methods Available

If it is found that inadequate correspondence results from inept composition, the remedy lies in proper training. Listed below are a number of training methods that are available.

1. Classroom training program.—The chief advantages of this training method are economy, efficiency in training numbers of people, group stimulus, and group interchange of ideas. With competent instruction and adherence to appropriate principles of training, the classroom method can be possibly the most effective and efficient method of securing results quickly and economically. The method is well adapted to situations where groups of ten or more are to be trained.

2. Group conference or clinic.—In the conference or

clinic the members of the group learn from each other through free and open discussion rather than from an instructor. This type of training is excellent when the group as a whole has all the knowledge and experience required but when individual members of the group have only partial knowledge. If most of the learners are weak in essentially the same or similar respects, however, the group conference is not recommended.

In the initial teaching of correspondence principles, the formal class seems preferable. For follow-up training, the conference method holds great promise.

3. On-the-job training by supervisors.—In surveys conducted by the author, a number of companies reported using this training method. Generally it is used in conjunction with other methods—occasionally, however, it is the sole approach. For it to succeed, the supervisor himself must be able to tell or show others how to write. If the supervisor is thus qualified, on-the-job training can be quite effective for either initial training or follow-up training and control. Often, however, supervisors are no better than their subordinates. If they are to administer on-the-job training, they must first be thoroughly trained themselves.

4. Correspondence bulletins.—Bulletins about effective letter writing are often prepared periodically or spasmodically for circulation among employees. Such bulletins, however, are a passive training device that place most of the burden on the learner. They seem inadequate, therefore, for carrying a very heavy training load. Their most effective use is as a follow-up or in conjunction with other training methods. Even there, however, they must be interesting, vigorous, concrete, and practically helpful to be of any significant benefit.

5. Correspondence manuals.—The so-called correspondence manual has two uses: (A) as a text for group training classes, and (B) as a reference work on effective correspondence principles and practices. The manual, like the bulletin, is a passive method depending upon the learner's diligence for its success. Used alone it can, if properly prepared, be of some limited help. It will generally prove more valuable if used in conjunction with other forms of training.

6. Carbon copy analyses.—One of the more effective methods of individual training is through the marking and correction of carbon copies which are then returned to the dictator. When the marking and correcting is intelligently and legibly done, the corrected copies show the writer his personal shortcomings and how to correct them. To the extent that space permits, they also point out better phraseology, better approaches and make similar constructive suggestions. This method of training is most effective when proceded by some other form of instruction so that the dictator will have a clearer understanding of the meaning and implications of the corrections he receives.

7. Guide letters.—The term "guide letters" is applied to pattern or model letters which may be adapted for use in lieu of the writer's own composition for commonly recurring situations. Guide letters thus resemble form letters except that they are not necessarily used verbatim and they are always individually typewritten. Although not generally considered to be a training method, they are likely to perform some secondary training function by simply exposing the dictator to examples of first-rate letters.

Obviously, none of the above training methods need be used to the exclusion of all others. As was indicated by the surveys referred to previously, many companies use from two to four of the methods concurrently. Farm Bureau, for example, used clinics, bulletins, and guide letters before they inaugurated their formal classroom program. While the classes were being conducted, the company published a manual, continued the bulletins, and continued the clinics.

The proper combination of various training methods must be determined according to the needs and objectives of the individual firm. The variety of combinations found in use by various companies—and with apparently successful results—suggests that there is probably no one "best" combination for any given firm.

Microfilm $4.45; Xerox $15.00. 347 pages.

1. Lewis, Leslie Llewellyn The Dartnell Short Course in Business Correspondence. Chicago: Dartnell Corporation, 1949, p. 10.

2. "The Language of Business," Fortune, 42 (November 1950), p. 113.

3. Davis, Ralph C. The Fundamentals of Top Management. New York: Harper and Brothers, 1951, pp. 637-662.

4. Jucious, Micael J. Personnel Management. Homewood, Illinois: Richard D. Irwin, Inc., 1952, p. 275.

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ECONOMICS, FINANCE

IMPACT OF FEDERAL-STATE RECIPROCAL DEDUCTION OF PERSONAL AND CORPORATE INCOME TAXES

(L. C. Card No. Mic 59-5481)

So Yong Chung, Ph.D.
University of Washington, 1959

Chairman: James K. Hall

The purpose of this dissertation is primarily to examine and evaluate the economic effects peculiar to the federal-state reciprocal deduction of personal and corporate income taxes. Between 1911-1937 the modern state income tax was adopted by some two thirds of the states. Until World War II the federal-state reciprocal deduction did not produce particularly serious economic effects because federal income tax rates before World War II were substantially lower than they are today. However the substantial increase in federal personal and corporate income tax rates since the beginning of World War II has given prominence and economic significance to the federal-state reciprocal deduction of income taxes.

Progressive taxation, measured in terms of tax burden and revenue, is largely represented by federal and state personal and corporate incomes taxes. The statutory progression of state income tax rates is converted into regression state income taxation by the introduction of the federal-state reciprocal deduction. Furthermore the progression of the statutory federal effective rates, and the combined federal-state effective rates is substantially reduced by the reciprocal deduction.

Income tax states which allow the single deduction maintain the statutory progression of their income tax rates because the single deduction provision of the federal law does not affect the state income tax base. Income tax states with the single deduction secure tax revenue at the expense of the federal treasury as measured by the amount of the state income taxes deducted against federally taxable income. However the federal-state reciprocal deduction forces state treasuries to share the burden of absorbing revenue loss caused by tax deductions. Since the state income tax base is substantially affected by the reciprocal deduction the state income tax becomes less reliable and less dependable as a source of revenue as a part of a state revenue system, because the amount of revenue to state treasuries from income tax with a given rate schedule, is within limits, at the mercy of the federal income tax policies.

To the extent that the combined federal-state effective rates are reduced by the reciprocal deduction, the possibility of state income taxes influencing industrial location and residence choice of persons in high income groups becomes modified. Moreover, the regressive nature of the federal-state reciprocal deduction partially nullifies certain special income tax features such as income splitting, the standard personal exemption and the exemption in form of tax credit.

The federal-state reciprocal deduction necessarily creates a functional relationship between the federal and state income taxes, and causes these two taxes to become interdependent. Such an interdependency complicates computation of tax liabilities which in turn tends to add significantly to taxpayer compliance burden as well as creating audit and other administrative complications on the part of state tax commissions.

The methodology of the computation of federal and state taxes under the reciprocal deduction is analyzed. The trial and error method of Arizona is contrasted with the simultaneous algebraic equations as solutions to the determination of tax liabilities.

The study concludes that the economic effects arising from the federal-state reciprocal deduction of income taxes are undesirable and tend to disturb fiscal systems of income tax states as well as to alter substantially tax burden distribution among persons in the various income groups in a manner contrary to that provided by the statutory tax rates. Microfilm $2.50; Xerox $6.60. 137 pages.

PROPOSALS FOR IMPROVING CONGRESSIONAL CONSIDERATION OF THE PRESIDENT'S BUDGET

(L. C. Card No. Mic 59-6180)

John Charles Mettler, Ph.D.
Clark University, 1959

Supervisor: James A. Maxwell

The purpose of this study is to examine recent proposals debated in Congress for improving Congressional consideration of the President's Budget. Since this is an economic study, the economic role of Congress is identified. Then the four major proposals are described, and arguments presented in Congressional hearings are stated. In conclusion each proposal is evaluated on the basis of the adequacy with which it conforms to and improves the economic function of Congress.

The economic functions of Congress are: to provide for the revenue needs of government, to contribute to economy and efficiency, to give consideration to fiscal policy, and, to a lesser extent, to maintain its legislative prerogatives.

Since resources are scarce, Congress must utilize some form of "social" marginal utility analysis leading to a satisfactory allocation of resources. In its procedures Congress must provide the opportunity to weigh the merits of competing programs. Only in the appropriation process, and particularly in the Appropriations Committees, does Congress have the opportunity to perform this essential task.

The proposals and the major conclusions drawn in this study are summarized as follows:

1. The accrued expenditures budget and appreciation proposal provides that the President's Budget and Congressional appropriations be stated in terms of goods and services received during the fiscal year rather than in the form of authority to obligate. This study concludes that Congress and its Appropriations Committees would be better able to control annual expenditures and formally review, on an annual basis, all long term programs. Congress would see the relationship between appropriation levels and the annual surplus or deficit and thus be in a position to make a deliberate fiscal policy decision.

2. The item veto proposal, whether through statute or Constitutional amendment, would empower the President to reject any item or items in an appropriation bill. It would speed up the appropriation process through a reduction of the time devoted to "log rolling" and to attaching legislative "riders." The Appropriations Committees would focus their attention more on national interest programs, free of "pork barrel" and extraneous legislation. The item veto should be granted by statute, because it could more readily be repealed if experience demonstrated that the President used it as a device to infringe upon the prerogative of Congress to appropriate funds.

3. The Joint Committee on the Budget, composed of members drawn from the Senate and House Appropriations Committees, would provide overall informed guidelines for committees concerned with revenue, legislation, and appropriations. This proposal is defective in that it would fragment the decision making process in the appropriations area. Experience has shown that meaningful guidelines cannot be established prior to an examination of budget details. A sound appropriation procedure requires a simultaneous evaluation of both the total and component parts of a budget. Furthermore, it could develop that proposed programs would be considered in the light of their contribution to fiscal policy rather than on the worthiness of the programs.

4. The consolidated general appropriation proposal provides that all general appropriations for each fiscal year be combined in one bill and that an annual expenditure limitations be placed on each appropriation item. This proposal has real merit. Congress would weigh all programs simultaneously and apply a form of "social" marginal utility analysis in setting relative program levels. Annual expenditure limitations would enable Congress both to maintain an improved program control and to consider the fiscal policy impact of its appropriation actions.

Informational provisions of the proposal calling for running totals on revenue, appropriations, and expenditures would materially facilitate Congressional action on legislation and appropriation.

Microfilm $3.85; Xerox $13.00. 300 pages.

INTERNATIONAL FINANCE AND NEW YORK: THE ROLE OF THE OUTFLOW OF PRIVATE FINANCIAL CAPITAL FROM THE UNITED STATES IN THE DETERMINATION OF THE SIGNIFICANCE OF NEW YORK AS A CENTER OF INTERNATIONAL FINANCE.

(L. C. Card No. Mic 59-5207)

James W. Nordyke, Ph.D.
Princeton University, 1959

This dissertation is composed of two main parts--(1) a theoretical discussion of the causes and consequences of the centralization of international finance at New York, and (2) a description of the methods by which private financial (that is, non-direct) capital is currently exported from the United States.

Since 1946 the volume of foreign-owned dollar-denominated short-term financial assets held primarily at New York has increased from less than $5 billion to more than $13 billion. This suggests that New York is becoming increasingly important as a center of international finance, that is, that institutions at New York are coming to be increasingly used for the exchange of financial assets between entities of different countries and for the holding of financial assets by foreigners.

The increasing importance of New York as a center of international finance can be considered either (1) as the latest step in the historical process in which the center of international finance has shifted from London to New York, (2) as posing a policy problem, as a part of which the United States must weigh against each other the advantages and disadvantages of containing a center of international finance, (3) as a result of an inherent tendency of finance, impelled by laissez-faire forces, to become centered, (4) as a phenomenon to be explained by economic location theory, or (5) as an example of the working internationally of the principle of comparative advantage.

This dissertation adopts in turn each of these approaches. The following conclusions result. There are discernible laissez-faire economic forces which promote the centralization of finance. These forces will encourage the establishment of a single predominant center of international finance. The United States possesses national economic and financial characteristics which make it the nation most likely to contain such a center. If such a center is to be established in the United States, New York will be the site. The existence of the center within the United States will not be of significantly large net direct advantage or disadvantage to the United States. But the center will be useful to the world as a whole. One factor which will affect the usefulness of the New York center to the nations and firms which use it will be the ability of the United States to export private financial capital. A consideration of the method by which and amounts of which such capital is and has been exported provides an indication as to whether this ability is likely to exist to a significant extent.

The export of private financial capital from the United States, chiefly by or through institutions at New York, occurs in a variety of forms. The commercial banks have been among the chief suppliers of this capital. Most of what they have supplied has been provided in connection with the activities of United States exporters and importers, or in cooperation with other financial institutions, foreign and domestic, public and private. In addition to commercial banks, other financial firms--foreign financing corporations, factors, commercial finance companies, and specialized export-import finance companies--have supplied small amounts of capital for international use. Investment companies have begun in a small way to purchase foreign securities, which have also been purchased in increasing amounts by other Americans. The total amount of private financial capital exported since 1946 has not been large, but that which has occurred indicates that New York is to some extent performing the capital export function of a center and that she is doing so with some versatility.

Microfilm $3.85; Xerox $13.00. 299 pages.

THE EVOLUTION OF THE BUDGETARY PROCESS IN MASSACHUSETTS

(L. C. Card No. Mic 59-6181)

Nicholas Louis Onorato, Ph.D.
Clark University, 1959

Supervisor: James A. Maxwell

This study investigates the development of the budgetary process in Massachusetts, occurring in five distinct stages. Only in the last two stages, however, was a conscious effort made to establish a system. Reforms in all stages were introduced by members of the general court to induce efficiency and economy and to restrict the fiscal powers of the governor.

The present comprehensive system was enacted in 1918 under the leadership of Representatives Young and Warner of the house ways and means committee. Chapter 244 of the general laws and Article 63 of the Amendments to the Constitution established an "executive budget." The governor was required to include in the budget all proposed expenditures and the means of financing them. In addition, he was granted the "item veto." To assure payment of obligations, spending agencies were required to deposit daily all money received on account of the commonwealth. These provisions, together with legislation enacted in 1855, requiring an independent post-audit by a popularly elected auditor, gave Massachusetts one of the most thoroughgoing systems among the States.

Although the procedures to implement the legal requirements were established about forty years ago, they remain basically the same today. While the system continues to be superior to those of many other states, the practices and philosophies developed for smaller and less complex budgets are not applicable today.

The traditional emphasis of the process on economy,

efficiency, and restriction of the financial powers of the governor, does not allow for the effective selection of either a well-balanced financial plan or an efficient system of administration. The itemization of the budget by subsidiary accounts, particularly, focuses too much attention at all levels of review and administration on the things to be bought rather than the things to be done and their costs. In the review process, concern with the accuracy of details frequently contributes to functional imbalance in the authorized financial plan. Moreover, the present itemized budget does not offer any incentive to spending agencies to administer their programs effectively because the natural stress of the system on the legality and propriety of fiscal transactions requires only that they stay within the authorized appropriations.

To achieve the goals of the budgetary process, Massachusetts should develop a performance budget. Each spending agency should establish a classification of accounts which would furnish the most meaningful information. The budget requests should state, as do those of the department of public works, what the proposed programs are and what they will cost. To assist in the determination of costs, a system of factorial budgeting similar to the one used in the department of mental health should be developed.

In selecting the programs, the budget bureau and the ways and means committees should be assured that the costs are adequate and that the spending agencies can administer their appropriations efficienctly and economically. The budget bureau should be well staffed with competent personnel to perform these functions and to indicate to the spending agencies how to achieve their programs with the authorized appropriations. The ways and means committees can be assured through a performance audit that the programs will be carried out efficiently and economically.

The performance budget does not provide for the efficient use of the resources made available to the spending agencies. This is the responsibility of the commission on administration and finance. The commission should be reorganized to furnish the commissioner of administration with the necessary powers and personnel to make continuous studies of the operations of the spending agencies for the purpose of installing economical methods and procedures. Microfilm $4.25; Xerox $14.40. 332 pages.

ECONOMICS, HISTORY

FACTORS AFFECTING TRADE UNION ORGANIZING OF MANUFACTURING FIRMS IN IOWA, 1946 TO 1957.

(L. C. Card No. Mic 59-5753)

Donald Thomas Butler, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Edwin Young

This study investigated the factors of geographic and urban location of the firm, the size and ownership of the firm, the background of the workers, bonuses, and the state and federal law to see to what degree any of them affect the ease of trade unions' organizing of the firms. After describing the factors, recognition of them by both management and union organizers was studied to see how well founded their tactics were in an organizing campaign.

All manufacturing firms in Iowa employing more than 100 workers were contacted by questionnaires and their experience with trade union organizing campaigns and the dates of the experience were recorded. From this information initial conclusions on geographic and urban location and size of firm as factors affecting organization were derived. These replies also served to isolate the firms organized during the years 1946 to 1957.

Interview-questionnaires were used as discussion guides with management representatives of nine of the firms experiencing organizing attempts in the time period, organizers of nine of the firms and 24 workers in six different firms. These interviews allowed each interviewee to develop the organization campaign and the activities of each side as well as the background of the work force and the working and legal environment. Thus the deep insight of the case study approach was sought rather than the broad insights of statistical correlations.

The study indicated that primary factors which affect organization negatively for trade unions are: first, the location of the firm in a rural area and the consequent agricultural background and hence lack of industrial experience of the workers; and second, home ownership of the firm if it is coupled with good liason between top management and the workers. Secondary factors are small size of plant, work experience of the employees of less than five or over fifteen years in the firm, bonus plans, and unfavorable legislative environment. All of these factors affect trade union organizing adversly.

Both management and organizer based their campaigns on rational motivation stressing economic advantage and personal freedom. Neither took into account completely the factors described above though the organizers with their "union education" campaigns indicated they best recognized the first factor, namely lack of industrial experience. Microfilm $2.50; Xerox $7.60. 165 pages.

MONEYLENDERS AND THE ECONOMIC DEVELOPMENT OF LOWER BURMA—AN EXPLORATORY HISTORICAL STUDY OF THE ROLE OF THE INDIAN CHETTYARS.

(L. C. Card No. Mic 59-3440)

Chester L. Cooper, Ph.D.
The American University, 1959

An exploratory historical study of the extent and nature of the influence of the Indian moneylenders on the development of Lower Burma. It covers the century from the British annexation of Lower Burma in the 1850's to the present.

The dissertation traces the growth of Chettyar moneylending activities and compares the significance of these activities in the field of agricultural credit with those of the Burmese moneylenders, the cooperative credit societies, the large commercial banks and the government financing and credit arrangements. Comparative analyses of interest rates and other aspects of credit are presented.

Trends in prices for paddy, land values, cost of living, standard of living, land alienation and rural indebtedness are analyzed. British policy is examined with respect to the various economic problems of Lower Burma, particularly the problems of agricultural finance and absentee land ownership. The developments under Japanese occupation and in the post-war period are dealt with. Particular attention is paid to the post-war plans, policies and progress of the government of Burma in connection with land redistribution and compensation for Chettyar-owned property which had been nationalized under the redistribution program.

Principal reliance in the research on those aspects of this subject that deal with the period prior to the invasion of Japan was placed on the reports submitted by government Settlement Officers in the period 1880-1939. In addition, the material available in various official surveys and inquiries was useful. For the post-war period, the official publications of the government of Burma provided the principal source material.

The results of this study indicate that the Chettyars had an important, possibly a definitive influence on the development of Lower Burma in the course of a few decades from sparsely settled swamp and jungle to one of the food reservoirs of the world. The extensive mortgage foreclosures of the mid-1930's resulted in more than a third of the occupied area of Lower Burma being placed in the hands of the Chettyars by 1937. Despite the widescale indebtedness and alienation of land that resulted from this, the study concludes that, by and large, the Chettyars' activity was beneficial to Lower Burma.

Microfilm $2.50; Xerox $6.60. 136 pages.

SLIDING WAGE SCALES: A THEORETICAL AND HISTORICAL EVALUATION.

(L. C. Card No. Mic 59-1484)

Harry I. Greenfield, Ph.D.
Columbia University, 1959

This study is an economic history of a technique of wage adjustment known as the sliding wage scale. Sliding wage scales as used in this paper refer to formal or informal arrangements between labor and management whereby wage rate adjustments are linked to price fluctuations. The focus of the study is on the reaction of labor (singly or collectively) at selected periods of American economic history, to changes in prices. Price changes in the "cost-of-living" and in products produced by specific groups of workers (e.g. coal, iron, copper, etc.) are shown to have been the major types of sliding wage scales. The three divisions of the paper are as follows:

Part I, "Historico-Ideological Aspects of the Wage-Price Relation." Here, early theories (and practices) linking wage levels to food prices are shown as antecedents of the treatment of wages and prices in classical political economy. Introduction of the idea of a lag between wages and prices leads to important conceptual and operational contributions by neoclassical economists. Issues in the British sliding wage scale practices are incidentally examined. Finally, implications of sliding scales for business cycle theories and in the full employment sans inflation controversy are analyzed.

Part II, "An Historical Survey of Sliding Wage Scales in the American Labor Scene." In this section of the paper it is shown (1) that rapid upward price changes caused labor to demand corresponding wage rate adjustments at very early periods of U. S. economic development and (2) that some of the actual adjustments took the form of a sliding wage scale. Applications of the sliding scale device are traced from the wage regulations of the 17th century to the produce price scales of the post Civil War period and finally to the cost of living sliding scales of the twentieth century, culminating with an analysis of the UAW-GM contracts of 1948 and 1950. Included in this section are measurements of the actual course of prices and wages under the agreements.

Part III, "An Evaluation of Sliding Wage Scales." The final section of the paper considers this wage adjustment technique from the point of view of trade union wage policy. Issues examined in this context are: the extent to which trade union policies are influenced by real wage consciousness; impact of sliding wage scales on the firms' operations; sliding wage scales and wage rigidity; inflationary aspects of the sliding scale device.

The concluding chapter (Chapter 9) examines the reasons for the abandonment by labor of the produce price sliding scale and the improbability of its recurrence. While cost-of-living scales (escalator clauses) retain contemporary viability doubt is expressed as to their efficacy in terms of a long run solution of wage-price relationships.

Microfilm $3.55; Xerox $12.00. 273 pages.

ECONOMICS, THEORY

A BALANCE SHEET FOR THE NATION: A STUDY IN CONCEPTS.

(L. C. Card No. Mic 59-6089)

John Oliver Blackburn, Ph.D.
The University of Florida, 1959

This study has as its major purpose the construction of a conceptual framework for the measurement of the national wealth, an objective which has been approached through the medium of a national balance sheet. Another purpose is the integration of the national balance sheet into a unified system of social accounting, to which end the relationships between the national balance sheet, the national income and produce accounts, and the flow-of-funds accounts are explored.

Most of the problems involved in developing the national balance sheet can be grouped under two main headings; namely, the scope of the balance sheet and methods of valuation. Other relevant issues concern the division of the economy into appropriate sectors and the relating of individual, sector, and national assets and liabilities. Due attention is paid to previous work in the field, especially that of Raymond W. Goldsmith of the National Bureau of Economic Research.

Sample national balance sheets for the years 1949 and 1950 are presented and are related in detail to 1950 figures for national income and product, and flow-of-funds. Since the study is concerned primarily with conceptual issues

and hardly at all with problems of collecting data, most of the figures used are drawn from secondary sources, mainly those developed in the flow-of-funds work or by Goldsmith.

The view of the economic processes suggested by the balance-sheet approach is not without implications for economic and monetary theory, some of which implications are explored in the study. Theoretical work with respect to stocks as well as flows of economic magnitudes appears to be in need of further expansion, a process which empirical work on the national balance sheet is likely to stimulate.

The study reaches a favorable verdict as to the feasibility of preparing annual national balance sheets on an official basis, even though there are some very difficult conceptual problems, the proposed solutions to which are not in all cases fully satisfactory.

Microfilm $2.50; Xerox $8.60. 190 pages.

EDUCATION

EDUCATION, GENERAL

CRITERIA FOR EVALUATING A STATE'S LEGISLATIVE AND ADMINISTRATIVE PROGRAMS FOR COMMUNITY-JUNIOR COLLEGE EDUCATION

(L. C. Card No. Mic 59-6091)

Kenneth August Brunner, Ed.D.
The University of Florida, 1956

The purpose of the study was to suggest criteria by which a state's junior college program may be evaluated.

First, however, a restatement of the objectives or goals of junior college education was necessary because a survey of the literature revealed there had been no extensive studies of the purposes or functions of the junior college in twenty-five years. In addition, it was apparent that a re-evaluation of its aims was in progress.

The research design called for these steps: collation of objectives found in the literature; construction of a rating scale incorporating the goals; organization of a jury of nationally recognized authorities in educational administration and finance and in junior college education including experienced heads of junior colleges and state public junior college coordinators; submission of the rating scale to the jurors; analysis of the rating scales; development of preliminary criteria from goals rated as "vital" or as "important" to junior colleges; and, then, revision of the criteria so they may be used in relation to the basic functions of government involved in such a program, viz. legislation and administration.

Various statistical techniques demonstrated that national authorities agreed on the objectives of community-junior college education to the extent that the restatement of its goals which follows could be depended upon by those who are responsible for providing and supervising such institutions as part of a state's educational program.

Twenty-two goals of community-junior college education were rated "vital" or "important" by the combined panel of jurors. Goals marked with an asterisk (*) were rated as "vital;" others, as "important."

Goals Related to Transfer Students

1. Prepare for further college study*
2. Prepare for professional education
3. Decentralize college educational opportunities
4. Relieve university for more specialized training
5. Make easier the transition from restrictions of high school to the freedoms of college

Goals Related to Terminal Students

6. Provide for general education*
7. Provide for sub-professional or vocational education*
8. Intertwine education for daily living with training for a vocation

Goals Related to Adult Students

9. Meet sub-professional or vocational needs of the community*
10. Offer short courses to satisfy special interests
11. Provide courses at all levels for persons past compulsory attendance age
12. Provide leisure-time education
13. Provide citizenship education, especially for foreign born.

Goals Related to All Students

14. Provide guidance services: educational, social, vocational*
15. Explore interests and abilities
16. Orient students vocationally
17. Provide individual attention
18. Provide leadership training
19. Provide smaller classes

Goals Related to All Citizens

20. Affect the community's cultural tone
21. Make possible economy of money
22. Serve the experimental function

Fourteen criteria were proposed for testing a state's legislation for community-junior colleges. Two of them concerned general legislative provisions; five, the grant of power to be made to state and local authorities; and seven, the provisions which should be made for state and local financial support.

Forty-six criteria were suggested for testing a state's administration of a community-junior college program. Two of them were concerned with general administrative provisions; seventeen, with the question of how a state governmental agency should provide leadership for local boards of education; twenty-two, with the state's policy on accreditation; and five, with the problem of certifying junior college instructors and administrators.

It is recommended that the proposed criteria be tested in actual situations by persons who would be most concerned with their use, specifically: (1) persons in state governmental agencies responsible for any phase of

operation, administration, or coordination of a community-junior college program and (2) members of and technical advisors to standing and special committees in state legislatures which are responsible for junior college legislation. From their experiences these public servants may suggest ways in which the criteria may be strengthened.

Microfilm $2.50; Xerox $6.40. 131 pages.

THE DEVELOPMENT OF AN INSTRUMENT TO EVALUATE THE ABILITY OF COLLEGE HOME ECONOMICS STUDENTS TO APPLY HOME MANAGEMENT GENERALIZATIONS AND FACTS IN THE SOLUTION OF HOMEMAKING PROBLEMS

(L. C. Card No. Mic 59-6626)

Anna Margaret Cameron, Ph.D.
The Ohio State University, 1954

The dissertation was concerned with measuring one aspect of a major objective of a college home economics program, the ability to think effectively on problems of the home—more specifically, the ability to apply home management generalizations and basic facts which might be used in making a management decision. It contributed to an evaluation program at the college level which was being carried out by the School of Home Economics of The Ohio State University.

The hypothesis formulated for the study was that a valid and reliable instrument could be developed to evaluate the ability of college home economics students to apply home management generalizations and pertinent facts in the solution of homemaking problems. In order to test the hypothesis, certain basic assumptions were accepted: (1) that developing the student's ability to apply principles as one aspect of thinking is an important goal of all college home economics departments; (2) that this ability can be satisfactorily sampled by the use of a pencil-and-paper test; and (3) that to use the test with only one group of home economics seniors, those enrolled in the home economics education curriculum, would be a satisfactory testing of the instrument since their program of work had been a very broad one. Also, this group of seniors represented over half of those with a major in home economics.

The Development of the Instrument

In testing the hypothesis, certain steps were followed in the construction of the instrument in order to make it as valid and reliable a measure as possible. The first step was the analysis of the objective in terms of the behavior involved in the application of home management generalizations. These behaviors, adapted from those listed by Smith and Tyler as involved in applying social facts and generalizations to social problems,[1] are:

1. The ability to see logical relations between generalizations and pertinent facts on the one hand and the factors involved in a problem on the other—to see whether a statement supports, contradicts, or is irrelevant to a given decision or conclusion
2. The ability to evaluate arguments presented in connection with a problem, and to discriminate between statements of fact, statements of opinion, and misconceptions
3. The ability to judge the consistency of a course of action with relation to goals—to judge the appropriateness of the course of action for attaining goals.

The instrument developed in the dissertation appraises the student's ability to see logical relations in applying management generalizations and basic facts to various homemaking problems. It also measures knowledge of these generalizations and facts. The final form of the test contains six homemaking problem-situations, each of which closes with an underlined decision representing either a proposed solution to the problem or a conclusion or evaluation regarding the way in which problems were met. Each problem-situation is followed by a group of fourteen statements which make use of factual information pertinent to management and management generalizations.

The instrument was constructed with two separate steps. In Step I the student is asked first to accept as true all statements following each problem-situation and then to decide which of these logically support or logically contradict the underlined decision or do neither. Such identification involves seeing the logical relation between a specific statement and the decision and factors involved in a situation. Step II of the instrument measures the student's knowledge of important facts and management generalizations. In this step the student is asked to judge which statements would in general be regarded as true or as false and which are almost equally likely to be either true or false.

In order to promote the fact validity of the instrument, the writer had the formulated home management generalizations by the core home economics teacher at The Ohio State University for their importance in different areas of home economics and their use with students in core courses, or those required in all curricula. A jury of home management specialists similarly checked the generalizations for accuracy and for their importance in management. In addition, the problem-situations used in the instrument were developed from the actual problems of homemakers.

During the various stages in the development of the instrument it was submitted to competent persons for their criticisms and suggestions. A preliminary form of the test was given to a small group of undergraduate students at The Ohio State University to determine needed revisions and to find the range of scores on problems.

An attempt was then made to eliminate ambiguous items and any mechanical factors causing confusion. The final test was geared to the level of the group for which it was intended by the elimination of the problem-situations, which were apparently too easy. The readability of the test was analyzed to be sure that it was not above the reading level of the group.

A key for the instrument was developed from six judges's classifications of statements. In Step I, 75 per cent of the statements used had the agreement of at least 80 per cent of the judges regarding correct classification of responses. Sixty-nine per cent of the statements used in Step II were agreed upon by better than 80 per cent of the judges. No statement was used in the test unless at least 60 per cent of the jury members agreed upon its classification.

Results of the Study

The test was given to sixty home economics education seniors at The Ohio State University who did their student

teaching during the academic year, 1953-54. The test scores were then analyzed to determine the accuracy of the instrument. The range of scores and standard deviations for Part I (Step I) of the test indicated that the section on seeing logical relations distinguished very well between various levels of ability. There was a very limited range of scores for Part II (Step II) on information; a greater spread than was obtained would have been desirable. The best spread of scores was given by those statements which were meant to "logically contradict" (in Part I) the decision in the test-situation.

An item analysis to determine statements which showed a discrimination of 20 per cent or better between upper and lower fourths of the group revealed that 64 per cent of the items in Part I and 42 per cent in Part II showed such a discrimination. The factors which appeared to be chiefly responsible for the poor discriminating qualities of some items were low jury agreement on the key, items being too easy for the group who took the test, and ambiguous wording.

Using the sixty test scores, the reliability of the instrument was determined by the product-moment method; the Spearman-Brown formula was the applied. The coefficients obtained were .871 for Part I and .461 for Part II. The reliability for true-false items alone in Part II was .639. The reliability for Part I of the instrument was high enough that this section of the test could be used satisfactorily for measuring individual achievement; for Part II, the reliability for all items was so low that this step of the test could not be considered useful even for measuring group accomplishment.

The correlation between Parts I and II of the instrument was .468, indicating the extent to which the two parts of the test were measuring the same behavior. The correlation of test scores with students' percentile rankings on The Ohio State Psychological Examination yielded coefficients of .42 for Part I and .45 for Part II, suggesting that the constructed instrument measures some factors other than general ability related to success in academic work.

Unfortunately, there was no satisfactory criterion available against which to validate the instrument. A student's application of management in a practical situation perhaps could be considered such a criterion, were it not for the fact that many factors besides actual ability influence one's application of management. Nevertheless, it seemed worthwhile to collect evidence regarding a student's ability to apply management in practical situations and to compare performance in the practical with that in the pencil-and-paper situation. Therefore, the writer made from two to four direct observations of twenty-one subjects in student teaching. Further evidence was collected through interviews with supervising teachers, with the University supervisors of student teaching, and with the supervisors of the home management house residence.

The evidence thus obtained for each student was evaluated, and subjects were placed into upper, middle, or lower groups, according to the individual's overt expression of management in practical situations. A comparison of these group placements with the student's placement in the upper, middle, or lower third of the test showed that students who were in the upper third on the test were as likely to do very poorly as very well in a practical situation. Those who placed in the lower third on the test were not superior in the practical situations.

In constructing the instrument, care was taken to follow procedures which would help to insure validity and reliability. However, it was recognized that face validity of the test was not completely established since there was some jury disagreement on the key. The reliability of the instrument also needed to be increased, since the correlation obtained for all items in Part II was quite low. Therefore, the following recommendations for improving the instrument were made:

1. The items should be made more discriminating in order to increase the reliability of the instrument
2. The test should be lengthened
3. Only statements with high jury agreement on the key should be used
4. The management generalizations should be used more than once in the instrument
5. After the instrument is refined, it should be given to a large group of subjects with a wide range of ability in order to establish the reliability of the test.

Use of the Instrument

While the instrument developed in the dissertation could be used to sample the student's ability to see logical relationships, this is only one aspect of the application of principles. Therefore, the results on the test would be much more significant if they could be used in conjunction with several other kinds of evidence of application ability. Such evidence might be collected through the use of essay or objective tests which evaluate the student's ability to make or choose decisions to problems and to support the decisions with reasons; also, evidence could be obtained through the use of check lists and observations in practical laboratory situations. The use of a variety of methods of appraising different aspects of the ability to apply management information would give a more complete picture of the student's skill in this respect than would the evaluation of any single aspect alone.

Microfilm $2.50; Xerox $8.80. 191 pages.

1. Smith, Eugene R., and Tyler, Ralph W. Appraising and Recording Student Progress. New York: Harper and Brothers, 1942, pp. 197-98.

Abstract published by special arrangement with The Ohio State University.

A STUDY OF THE SCIENCE ACHIEVEMENT TEST SCORES OF EIGHTH-GRADE PUPILS IN SELECTED JUNIOR HIGH SCHOOLS

(L. C. Card No. Mic 59-6602)

Joseph D. Dameron, Ed.D.
University of Kansas, 1959

As science achievement of public youngsters is a most important consideration due to present world conditions, the investigator chose to evaluate the level of science achievement as evidenced by eighth-grade pupils in three different organizational patterns for science instruction in seven Mid-western junior high schools on a recently published science achievement test.

The junior high schools selected for investigation were characterized by the following organizational pattern for science instruction on the eighth-grade level:

Pattern A: The common-learnings (unified studies or core) program including science as a function of the program.

Pattern B: The conventional science class, taught daily as a separate subject for two semesters of the academic year.

Pattern C: The conventional science class, taught daily as a separate subject for two semesters of the academic year.

The eighth-grade science pupils in Pattern A were in the second year of a core-type program. Science was included in the program, in combination with English and social studies during a three-hour block of time in the seventh as well as the eighth grade.

The Pattern B junior high school youngsters had completed one semester of science in the seventh grade and were commencing their second semester of science as a required course in the eighth grade. The pupils in Pattern C were commencing their general education science requirements on the junior high school level. They had received no formalized instruction in science as a part of their required program in the seventh grade and were taking two semesters of science in the eighth grade.

Cognizant of several limitations, the investigator felt that the following conclusions were evident from the analysis of the 1495 pupil intelligence, pre- and post-test science scores:

1. The average converted science scores for the seven junior high schools ranked at the 98th percentile of the schools used in norming the science test, both on the pre- and post-test. It was apparent that while the sample population manifested high science achievement on the pre-test in relation to pupils in the norming population, this high relative standing was maintained on the final administration of the science achievement test.

2. That while the 728 girls evidenced a significantly higher degree of intelligence, the mean science achievement test scores of the 767 boys were significantly higher than the science scores of the girls, both on the pre- and post-test.

3. When the basic assumptions pertaining to the application of the technique of analysis of variance and covariance were met, the investigator was able to conclude, without qualification, that there were no significant differences in mean science achievement test scores among the three patterns for junior high school science instruction under investigation.

While it was found that the pupils in the selected junior high schools manifested a relatively high level of science achievement, and that the achievement level among the patterns was comparable, the teaching methods employed and the content of the courses were investigated only indirectly, in the results of the science testing program. Further investigations concerned with teaching method, course content, and teacher preparation and qualification for science instruction at this age level would lend significance to the findings of this investigation. It is also recommended that future investigations of this nature be conducted throughout a two-year period, beginning at the start of the junior high school experience in order to obtain a better measure of the elementary school science experiences and to further test the effectiveness of the three patterns for junior high school science instruction. Evidence of an exceptional elementary school science program was found in the pre-test science achievement scores of the pupils in Pattern C, a pattern that did not include science as a part of the junior high school curricular offering during the seventh-grade year.

Microfilm $2.75; Xerox $9.40. 209 pages.

A STUDY OF THE PERSONAL AND SOCIAL BEHAVIOR OF BOYS AND GIRLS IN REORGANIZED AND NON-REORGANIZED SCHOOL DISTRICTS

(L. C. Card No. Mic 59-5761)

William Dean Dowling, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Burton W. Kreitlow

Statement of the Problem:

The purpose of this study is to determine whether there are differences in the personal and social adjustments of boys and girls in reorganized and non-reorganized school districts. It is a part of the "Long-term Study of Educational Effectiveness of Newly Formed Centralized School Districts in Rural Areas" which compares educational opportunities, achievement, costs and community structures in reorganized and non-reorganized school districts.

Hypothesis I: There are no significant differences among means of scores on section and total scores of the California Test of Personality achieved by boys and girls in reorganized and non-reorganized districts.

Hypothesis II: There are no significant differences among means of scores on sections and total scores of the California Test of Personality achieved by boys and girls in reorganized and non-reorganized districts when socio-economic status, teacher ratings of social qualities and emotional stability are controlled.

Procedure:

Population

Five reorganized and five non-reorganized districts were used in the study. The sixth grade students, their parents and teachers supplied the data. A sample of 88 was selected from each group (boys and girls in reorganized and non-reorganized districts), giving a total of 352 students for whom data were analyzed.

Data gathering devices

School administrators were queried as to any differences they believed existed between the personal and social adjustments of students in the two types of districts. They believed students in reorganized districts got along better with others, had a greater sense of belonging, had more highly developed cultural skills, were happier in school and had healthier attitudes toward citizenship than students in non-reorganized districts. Five parts of the California Test of Personality were selected to measure students' responses to questions related to the areas mentioned by the administrators. Parents provided data for the socio-economic status scale. Teachers rated students at first grade on social qualities and emotional stability.

Treatment of the data

The test for significance of differences between percentages, analysis of variance and covariance and Pearsonian

coefficients of correlation were used to describe and analyze differences.

Results:

Statistical differences were found among means of total scores of the four groups. Differences were found between boys in reorganized and non-reorganized districts on total scores, Sense of Personal Worth and Community Relations scores in favor of boys in non-reorganized districts. No statistically significant differences were found between boys for the other sections. No differences were found for girls on any of the sections.

Forty five of the 60 items were answered correctly by larger percentages of boys in non-reorganized districts. Thirty were answered correctly by larger percentages of girls in non-reorganized districts.

Correlations between dependent and independent variables were negligible to low.

Differences between means of Sense of Personal Worth scores for boys remained significant when the independent variables were controlled. Differences between means of Community Relations scores remained significant when socio-economic status and social qualities were controlled but disappeared when emotional stability was controlled.

Conclusions:

Boys in non-reorganized districts are able to supply more correct responses to the Sense of Personal Worth and Community Relations sections of the test than boys in reorganized districts.

There is no difference between the personal and social adjustments of girls in reorganized and non-reorganized districts as measured by the California Test of Personality.

Statements made by school administrators about the personal and social adjustments of students in reorganized and non-reorganized districts are not upheld by scores achieved on the California Test of Personality by those students.

When differences in emotional stability are considered, no significance remains between the differences of the means of scores of the Community Relations section for boys. Microfilm $2.50; Xerox $6.80. 142 pages.

A DEFINITION OF THE ROLE OF THE JUNIOR NOVEL BASED ON ANALYSES OF THIRTY SELECTED NOVELS

(L. C. Card No. Mic 59-3475)

Arthur Stephenson Dunning, Ph.D.
Florida State University, 1959

This study examines and evaluates the junior novel in relation to its use in the literature program of the secondary school. Because the literary quality of the junior novel inevitably affects its relationships to the curriculum, critical analyses of thirty selected novels serve as focus for the discussion. The study has five sections.

I. The persisting need for a literary genre such as the junior novel is established historically. Theory, research, and practice involving the study of literature are traced through the developing secondary school. A history of the literature curriculum (with discussion of important issues relating to purposes, methods, and materials) is important preface to consideration of the junior novel.

II. The junior novel is defined, its beginnings, growth, and present status are explored, and its critical and scholarly backgrounds are examined. The peculiar problems of selection facing teachers and librarians are indicated. A crucial issue is posed: Are the nature and quality of the junior novel such that the genre warrants serious consideration as a curriculum material?

III. Two considerations are developed: the method for selecting a group of novels and the plan for the critical attention to be given the novels. Seven school and seven public librarians, qualified as "Expert Librarians," submitted lists of junior novels popular with adolescents. From the books listed by the librarians and measured against certain rigid criteria, a group of thirty books is selected. Representative writers include Betty Cavanna, Henry Gregor Felsen, and Mary Stolz. In outlining the plan for analysis, certain "conventional" and "special" criteria are brought together under five categories: style; structure; characterization; theme; and adult role, adult-adolescent relationships. Critical statements listed under each aspect are designed to reveal something of the special nature of the junior novel.

IV. Thirty separate analyses demonstrate the range, the differences, and the similarities of the selected books. Bound together through common attention to five critical aspects, the analyses nonetheless reflect subjective evaluation of individual works. After the analysis is completed, each book is rated on all five critical aspects.

V. Ratings of the books on the critical aspects show that the quality of a given author's work is sometimes uneven, that there is a significant range in the literary quality of the selected novels, and that the writers of the selected novels do a significantly better job on some aspects than others; style, for example, is consistently judged more effective than is the delineation of adult-adolescent relationships. After several characteristics of the genre are noted, conclusions are drawn concerning the role of the junior novel in the literature curriculum of the secondary school. Representative conclusions are: (1) that junior novels characteristically meet certain curriculum needs--in theme-centered units, in extensive, "outside reading" programs, and as supplement to intensive, in-class study of literature; (2) that the junior novel is adequate as instructional material for teaching how to read, judge, and enjoy fiction, and serves students in establishing their own criteria for literary satisfaction; (3) that some junior novels serve to dramatize the nature of adult life, guide students toward better personal adjustment, and legitimately provide for the escape function of literature; and (4) that junior novels, in providing teachers with literature centered in the known interests of adolescents, offer teachers opportunities to determine profitable, realistic goals for the study of literature.

Specific recommendations concerning school use of the junior novel and several areas of needed research on the junior novel are indicated.

Microfilm $4.55; Xerox $15.40. 356 pages.

FACTORS RELATED TO ACCOMPLISHMENTS OF SELECTED HIGH SCHOOL GRADUATES IN LOUISIANA

(L. C. Card No. Mic 59-5513)

Caroll Woodie Eubanks, Ph.D.
Louisiana State University, 1959

Supervisor: Dr. Morris N. Abrams

This study was concerned with the post-high school accomplishments of a selected group of graduates in Louisiana.

The Normative-survey method with the questionnaire technique was used in securing the data from the graduates in this study.

Principals of twelve high schools cooperated in this study by furnishing the names, addresses and IQ scores of their 1952 graduates. A questionnaire was mailed to 732 of these graduates and 347 of them returned completed questionnaires. The data from these completed questionnaires and from the cooperating high schools form the basis of this study.

An increase in IQ scores was closely paralleled by increased attendance and graduation from college. The data indicated that as IQ scores increased there was a decrease in attendance in schools other than college.

The study revealed that graduates, whose fathers had achieved higher occupational status tended to aspire to higher educational attainments.

The data indicated that as the father's monthly income increased there was a greater tendency toward college attendance and graduation by the graduate. A slight decrease in attendance in schools other than college was noted with increased paternal income.

It was indicated by the data in the study that the higher the level of parental education the more likely the graduate was to pursue educational goals beyond high school. This was especially pronounced if the parents had achieved a high school education or higher.

The data indicated a decrease in college attendance and graduation accompanied an increase in the number of siblings of the graduate. An increase in attendance in schools other than college was indicated with an increased number of siblings.

The study indicated that in those families where the siblings attended college there was a greater likelihood that the graduates studied would also attend.

The graduate's own decision and parental influence were indicated as being most important in determining his post-high school plans.

A very close relationship was indicated between the graduate's aspirations and his accomplishments.

The data indicated that almost one-half of those students who attended college had some form of scholarship.

The most frequent reasons indicated by graduates for not furthering their education was getting married and securing a good job.

The study indicated that the greater the number of extra-curricula activities participated in by the graduate during high school, the more likely he was to attend college.

It was indicated that the occupational status of the graduate was strongly influenced by his educational attainments.

The data revealed that although some fluctuation existed between the graduate's educational attainments and his income there was generally a positive relationship.

College attendance was considered to be beneficial by both those who attended college and those who did not.

The data indicated that more men than women attended college; however, the drop-out rate was higher with the men.

Location of the graduate's residence is indicated as being influential in the decision concerning college. Those graduates living in a city where a state supported college was located were more prone to attend college than were the others. This influence was indicated in all IQ ranges.

The study revealed that legislative scholarships were most frequently granted to those graduates from homes in the middle income group.

Microfilm $2.50; Xerox $6.00. 122 pages.

ANALYSIS OF FACTORS AFFECTING CURRICULUM PLANNING IN PAKISTAN

(L. C. Card No. Mic 59-5449)

U. M. Saleem Khan Farani, Ed.D.
State College of Washington, 1959

Supervisor: Dr. Gordon McCloskey

This study deals with the analysis of factors affecting curriculum planning in Pakistan. Pakistan got her independence in 1947. She inherited a system of education based on economic and political concepts quite different from that of an independent state. Independence has given her the opportunity to think of her own needs and problems. This opportunity is making a demand that her educational development should be firmly rooted in the enduring subsoil of the nation's culture and be based on the needs and requirements of the country and on the scope of its natural resources and capacity of development. Her curriculum requires changes to fulfill the developmental needs of the country based on the features of the country in the changed position. The study of these features and needs reveal that there are many developmental factors relating to the various phases of the country which are making demands for certain changes in the inherited curriculum. These factors are: geographical, meteorological, hydrological, topographical, ecological, demographical, ethnological, economic, social, cultural, religious, political, and educational.

This study was an attempt to find out how these factors in their details make a demand for changes in the aims, nature, content, method, organization, and facilities of educational programs for the development of a good and economically efficient citizen of Pakistan and for the achievement of social, economic, and cultural objectives of the State. The procedure of analysis has been very simple. The main features of the country have been described first. Then the needs and developmental factors have been educed from these features. Finally, the implications of these features and developmental factors have been described. In the analytical procedure, each factor has been critically analyzed to determine the basic items of curriculum (items for general education, items for special and professional education, and special items covering administration, research, and training).

Evaluation of the current curricula has not been intended in this analysis, but this analysis has raised some

interesting points which are given in the form of conclusions and which can act as guiding principles in curriculum planning for the country.

Basically, the factors imply that curricula must include, besides general basic education requirements, (1) knowledge of the features and developmental factors of the country and the role of the countrymen, (2) plans for making the citizen of Pakistan physically, economically, and socially efficient, (3) provisions for training skilled technicians, workers, professionals, and administrative personnel, (4) provisions for inculcating respect for the values and ideology of Pakistan and for developing men and women of moral integrity, (5) provision for creating and developing a sense of responsibility among the citizens to keep their national honor and freedom intact, (6) provisions to prepare the people of Pakistan for an honest, democratic, and peaceful life, and (7) provisions to create in them a spirit for guarding their own rights and for performing their duties to others honestly and well.

This analysis has given guidance for planning the curriculum and affords clues for evaluating and scrutinizing curriculum development.

Microfilm $2.60; Xerox $9.00. 197 pages.

THE ACHIEVEMENT OF NEGRO PUPILS IN MIXED AND NON-MIXED SCHOOLS

(L. C. Card No. Mic 59-5492)

James Henry Fortenberry, Ed.D.
The University of Oklahoma, 1959

Major Professor: Associate Professor Claude Kelley

The primary objective of this study was to compare the reading, arithmetic, and language achievement of Negro pupils in mixed and non-mixed educational situations over two year periods of time.

The students were members of the eighth and ninth grade classes in the junior high schools in Oklahoma City which are attended by Negroes. The students were equated on the bases of language and non-language intelligence.

Fisher's "t" test of significance of the differences between independent means was calculated for mean achievement gains made, in the three subject areas during the two year periods, by pupils with similar language and non-language intelligence who attend mixed and non-mixed classes.

Conclusions drawn from the study were:

(1) Combining the races in school seemed to benefit the Negro pupil through greater achievement in arithmetic and language, but lesser achievement in reading.

(2) Failure of Negroes to achieve as well in mixed reading groups as in non-mixed reading groups might be due to difficulties encountered in curricular and communicative differences when changing to a desegregated school.

(3) In general, Negroes achieve better in mixed than in non-mixed classes.

The results of this study suggest the following recommendations:

(1) Studies of this type should be made of the achievement of Negro children of other ages and in other sections of the country who attend mixed schools.

(2) Other research of this type should be planned in such a manner that the educational experiences of the pupils, during the time they are studied, will be controlled.

(3) Studies of this type should be made of white children.

(4) School desegregation should proceed so that Negroes, as a group, will be better educated and as a result, contribute more to our society.

Microfilm $2.50; Xerox $6.80. 145 pages.

AMATEUR RADIO OPERATION IN MISSOURI, AND ITS IMPLICATIONS FOR INDUSTRIAL ARTS EDUCATION.

(L. C. Card No. Mic 59-5625)

Isaac Paul Hampton, Jr., Ed.D.
University of Missouri, 1959

Supervisor: H. H. London

Purpose of Study: The purpose of this study was to ascertain important experiences, viewpoints and activities of the amateur radio operators of Missouri, and to ascertain what implications this hobby has for Industrial Arts and Adult Education programs in Missouri.

Method of Research: Data for the study were obtained from information forms sent to 1000 Missouri residents who held amateur radio operator's licenses.

Summary: Amateur radio operation in Missouri has experienced considerable growth in the last decade. The average age of the Missouri amateur radio enthusiast is 35.5 years, and he has been a license-holder for two years or over. His income and education are above the average for all Missouri residents, and he expends considerable time and money in pursuit of the hobby of amateur radio.

Less than half of the amateurs of Missouri were employed in radion, electronics, or some allied field.

More hobbyists indicated that they were professional people, technicians or high school or college students than any other occupational category.

The majority of Missouri radio amateurs got started in their hobby through the reading and study of technical books and journals. This has also been the most important source of help and assistance in pursuing the hobby.

The hobbyists surveyed thought that subjects dealing with electronic principles, Government regulations and operating procedures were most important for an amateur to know.

Eighty-five per cent of the licensed amateur radio operators in Missouri have an amateur station that is in operation.

Seventy-five per cent said that they preferred voice methods of communication over telegraphic methods.

Most of the hobbyists indicated that they operated on frequencies below thirty megacycles.

A large majority of the amateurs surveyed approved

the suggestion that courses of instruction in their hobby be offered to interested persons in their community. They were largely opposed to having this kind of education be the responsibility of the public schools, however.

Conclusions: Amateur radio operation attracts people of all ages and from all walks of life. An average or better education, and a good reading ability seems to be valuable to these hobbyists.

The mean annual earnings of Missouri radio amateurs is somewhat above that for employed persons on a national average.

It appears that the individual's regular occupation has relatively little effect on his activities as an amateur radio operator.

Of all the activities that these hobbyists could engage in, only a few appear to have much attraction for most individuals.

Independent reading and study seem to be the most important sources of help and assistance to those pursuing this hobby.

It appears that amateur radio operators of Missouri are able to gain sufficient knowledge about the hobby without resorting to formal courses of instruction.

It appears that amateur radio operation is a desirable way to develop interests in the science of electricity and electronics among ordinary citizens.

It would seem that the public school has contributed relatively little knowledge about electronics needed by those individuals who engage in the hobby of amateur radio.

Microfilm $2.50; Xerox $6.40. 132 pages.

STATUS OF DRIVER EDUCATION IN THE UNITED STATES: A STUDY OF COURSES AS DESCRIBED BY STATE AND LOCAL SCHOOL SYSTEMS IN RESPONSE TO SPECIAL INQUIRY.

(L. C. Card No. Mic 59-3441)

Norman Key, Ed.D.
The American University, 1959

Chairman: Samuel Engle Burr, Jr.

Statement of the Problem

Since the introduction of high school driver education in the early 1930's, it has been acclaimed for its accident-reducing benefits, and the number of courses has increased rapidly throughout the United States. The problem of this study has been to make an assessment of driver education and to present for use by school systems, the administrative and instructional practices, the standards for professional personnel, and the scope and standards of driver instruction.

Methods Employed in the Study

An eight-page questionnaire was mailed to the forty-eight states in January of 1958. They responded to the eight-page questionnaire with useful data. A fifteen-page questionnaire which sougnt supplementary information was sent to 585 selected local school systems throughout the United States. Useful data were received from 301 systems, a return of 51 per cent.

Combining the data from both questionnaires, the writer has used tables and charts extensively for clarity and brevity, and has described recent developments in administrative and instructional practices.

Results of the Study

In forty-seven out of the forty-eight states the responsibility for supervising driver and safety education was assigned to designated professional personnel. Of 301 local school systems, 288 assigned professional personnel to supervision of driver and safety education.

The training requirements for high school driver education teachers met nationally recommended standards in only fifteen states. Only eight states required college-credit courses in driver and safety education for college personnel who prepared teachers in the field.

Only half of the driver education teachers devoted full time to the subject. Typically, the driver education teachers had thirty-nine students per period in classroom instruction, and four students per period in practice driving. In many school systems these teachers offered courses for adults and out-of-school youth in evenings and on weekends, and summer courses for an "overflow" of high school students.

Driver education was offered in 57.5 per cent of the public high schools, usually at the tenth grade level, and 46.2 per cent of the eligible students were enrolled. The typical student received thirty clock hours of classroom and six clock hours of practice driving instruction.

Most practice driving cars were borrowed from automobile dealers, but a trend toward school ownership of the cars was indicated.

The hourly instructional cost per student averaged $1.02 in the regular semester course, $.91 in the summer course, and $1.43 in the course for adults and out-of-school youth.

Practice driving enrollees had a personal-injury accident rate of one per 8,599 enrollees. None of the injuries was serious, and there were no fatalities.

Conclusions

Over-all responsibility for driver education is accepted by school systems, but there is a need for strengthening leadership through additional and better qualified supervisory personnel. States should establish respectable standards for college personnel who train driver education teachers, and most states should raise the training requirements for high school driver education teachers.

Strong educational leadership and strong public support are needed to extend driver education to all eligible students. Research is needed to help increase the number of students a teacher can handle in practice driving instruction, and to validate materials and teaching methods. Cost studies are also needed.

Additional full time teachers are needed, and more driver education courses should be offered in summer.

Microfilm $3.20; Xerox $11.00. 248 pages.

DISTINGUISHING CHARACTERISTICS OF STUDENTS ENTERING THE PUBLIC VS. THE PRIVATE INSTITUTIONS OF HIGHER EDUCATION IN WISCONSIN

(L. C. Card No. Mic 59-6976)

Margaret Louise Knueppel, Ph.D.
The University of Wisconsin, 1959

Supervisor: Dr. Avril S. Barr

Higher education in the United States today is experiencing new and greater pressures than ever before in fulfilling its functions and responsibilities to society. The needs of the future in higher education as dictated by tremendous increases in population as well as by the need for better and greater development of specialized talent, have created a challenge and an opportunity to those presently concerned with higher education. American higher education is characterized by a wide variety of forms and programs and interests. Differences in ultimate control -- private or public -- provide a basic distinction between institutions of higher education in this country. Higher education has been traditionally a competitive world, but today colleges and universities have recognized the need for unified action and cooperative planning for the future. It is now a generally accepted fact that both private and public institutions share jointly and respectively in this overall planning for the developing situation in higher education.

In the state of Wisconsin, the Joint Staff of the Coordinating Committee for Higher Education has initiated and completed a number of research studies on higher education in Wisconsin -- data of the past and present, as well as projections for the future. The earlier studies dealt with students in the public colleges only, but more recently, through the interest and cooperation of the private colleges of the state, many of the studies now include data from the private institutions as well.

In Wisconsin, the pattern of increase in private college enrollment in the last twenty-five years has been roughly similar to that of the public college enrollment. But the gross figures do not show if the private and public colleges and universities serve the same range or cross-section of the college-going population. Each group of institutions, private or public, may be serving students with distinctive personal, socio-economic, and geographic characteristics.

This investigation proposed to determine whether or not there were characteristics or factors which would distinguish between students choosing to enter the public vs. the private colleges and universities of Wisconsin. Seventeen private and eleven public institutions of higher education in Wisconsin agreed to cooperate in this study through the coordinating Committee for Higher Education and the Wisconsin Association of Presidents and Deans of Liberal Arts Colleges. These twenty-eight, four-year, degree-granting institutions offer curricula in liberal arts and teacher education. Other programs are available in these colleges and universities, but are not common to each of the participating institutions, therefore were not included in the study.

Detailed background and personal data was collected on a twenty percent sample of the full-time freshmen enrolling in September, 1958, in either the liberal arts or teacher education curricula in the twenty-eight colleges and universities mentioned above. A questionnaire designed for this study was mailed to every fifth student accepted for admission by the participating institutions before matriculating in the institutions involved. A very high percentage of student response (76%) created a research sample group of 1665 students after corrections were made for drop-outs and multiple applications.

The investigation proceeded to collect data in eight major areas of interest. These were (1) identifying information, (2) mental ability and high school achievement, (3) high school background, (4) future plans, (5) family background, (6) geographic location, (7) financial responses for college, and (8) college choice. The data of these areas were coded on IBM cards and tabulated; then these numerical lists were uncoded to produce tables of counts. These counts were computed into percentages and proportions, and it was on this basis that the two groups of students -- private and public -- were described and compared.

The results of the study of these two groups of students showed that there appeared to be no characteristics whose presence or absence distinguished one group from the other. Rather there were differences in the quantity or the quality of the characteristics observed between the two groups. Most of the differences seemed to be only slight or moderate in degree. In a few situations, the differences were marked. The noteworthy differences between the two groups of students were:

1. The ratio of state to out-of-state students attending.
2. The type of home community from which the students came.
3. The distance of the colleges attended from home.
4. The income level of the families of the students.
5. The occupational levels of the fathers.
6. The distribution of mental ability and achievement among the students.
7. The future plans for graduate work.
8. Family experience with college going.
9. The number and amount of scholarships received.
10. Attendance at college of first choice.
11. The reasons for not attending the college most desired.
12. The motivations for higher education.
13. The reasons for choosing a college to attend.
14. The degree of satisfaction with the selection of college made.

However, there were more characteristics that were similar or only slightly different between the two groups. It is believed that further analysis of the data would reveal more or greater differences between colleges within the private and public groups, than between the two groups of colleges treated as totalities.

It seems therefore, that in most respects, private and public colleges as groups of colleges, are serving similar ranges of student populations. Very few of the factors observed seem to be individually important in affecting the choice of college to attend. There definitely appear to be many clusters of several characteristics that are interrelated and influential in their effect on the students' selections of colleges to attend.

The results of this study could help to answer questions which both the private and public institutions of higher education in Wisconsin face in determining their respective and joint roles in the desirable and necessary expansion of programs and plants in order to meet the anticipated increase of college-bound youth in Wisconsin. The results of the study emphasizes the continuing need for cooperative

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

study and investigation between the private and public education interests of the state in adjusting the projections of future enrollments to the actual developing situation.

Microfilm $3.50; Xerox $11.80. 270 pages.

AN ANALYSIS OF HIGH SCHOOL COURSE PREPARATION AND ACADEMIC SUCCESS AT THREE TEACHERS COLLEGES IN THE STATE OF WASHINGTON

(L. C. Card No. Mic 59-5451)

George Kontos, Jr., Ed.D.
State College of Washington, 1959

The purpose of this study was to determine the effect of the proportion of non-academic high school course preparation upon the cumulative grade point average at selected intervals in the educational career of students entering the three teachers colleges in the state of Washington. The intervals at which selection of data was made are as follows: (1) time of high school graduation, (2) completion of the freshman year of college, (3) time of college graduation, and (4) time of withdrawal and/or transfer from college prior to the completion of the freshman year.

The Pearson product-moment coefficient of correlation formula was applied to the data to test the nine null hypotheses considered in this study, namely, there is no significant relationship between the proportion of non-academic high school course preparation and the following: (1) cumulative high school grade point average for students completing their freshman year of college, (2) cumulative college grade point average at the completion of the freshman year of college, (3) difference between high school cumulative grade point average and college cumulative grade point average at the completion of the freshman year of college, (4) cumulative high school grade point average for students graduating from college, (5) cumulative college grade point average at the time of college graduation, (6) difference between the cumulative high school grade point average and the cumulative college grade point average at the time of graduation, (7) cumulative high school grade point average for students who withdrew from college prior to the completion of their freshman year, and (8) cumulative college grade point average for students who withdrew from college prior to the completion of their freshman year, and (9) difference between the cumulative high school grade point average and the cumulative college grade point average for students who withdrew prior to the completion of their freshman year.

The results indicated that for College A, hypotheses 3, 4, 5, 6, 7, and 9 were not rejected. Hypotheses 1, 2, and 8 were rejected at the 1 per cent level of significance. For College B, hypotheses 1, 2, 3, 4, 5, 6, 7, 8, and 9 were not rejected. For College C, hypotheses 1, 2, 3, 5, and 9 were not rejected and hypotheses 4, 6, 7, and 8 were rejected at the 1 per cent level of significance.

When the sum of the total population of all three colleges was considered, it was found that hypotheses 1, 3, 4, 5, 7, 8, and 9 were not rejected. Hypotheses 2 and 6 were rejected at the 5 per cent level of significance.

Educators at the high school level have frequently discouraged their students from participation in non-academic course work if the student had college aspirations. The inference has been accepted that non-academic high school course preparation would not contribute to a successful college career. Based on the conclusions reached by this study, it is suggested that variables other than those of non-academic high school course preparation be examined for their value in the prediction of successful completion of college enrollment from the freshman year to graduation.

Microfilm $2.90; Xerox $10.00. 221 pages.

A FOLLOW-UP OF ENGINEERING GRADUATES, UNIVERSITY OF MISSOURI, 1946-1955.

(L. C. Card No. Mic 59-5627)

Jay Lawrence Logue, Ed.D.
University of Missouri, 1959

Supervisor: H. H. London

PURPOSE: To ascertain the various types of positions held by the graduates of the College of Engineering of the University of Missouri, the extent to which the education they received was meeting their needs, and their suggestions for improvements. Further, the study sought to obtain the respondents' evaluation of drafting as a part of the Engineering curriculum.

METHOD OF RESEARCH: Data for the study were obtained from the records in the Engineering Dean's Office and from information forms completed by 778 of 1,598 graduates of the College of Engineering. Percentage tables were used in handling the data.

SUMMARY: One thousand five hundred ninety-eight individuals received a Bachelor's Degree from the College of Engineering of the University of Missouri during the ten year period with which the study was concerned.

The 778 respondents were divided among the divisions of the College of Engineering as follows: Mechanical 218, Electrical 209, Civil 189, Chemical 134, and Agricultural Engineering 28.

The respondents were located in 41 states, the District of Columbia, Hawaii, and seven foreign countries.

The Engineering graduates were working at 28 different jobs within 37 occupations; 578 were in the occupation of original employment.

Physics, Algebra, Trigonometry, English Composition, and Public Speaking were the non-engineering courses considered by the respondents to be of most value to them in their profession.

Engineering courses considered to be of most value to the respondents were: Land Surveying, Chemical Process Calculations I, Reinforced Concrete, Alternating Current Circuits, Engineering Drawing and Engineering Thermodynamics.

The respondents rated Sketching as the type of drafting used most often in their present occupation. Sketching was the phase of Engineering Drawing rated as being the most valuable to the respondents. Auxiliary Views was rated the most useful phase of Descriptive Geometry.

CONCLUSIONS AND IMPLICATIONS: It appears that a large percentage of the graduates lacked proper guidance in the selection of non-engineering courses.

Engineering college graduates should have a greater opportunity for participation in actual engineering problems and practical experiments while in college.

Insofar as scholastic success is concerned, it makes little difference whether a student completes all the requirements for the Bachelor's Degree at the University of Missouri or transfers credit from another school.

There is a definite need for additional training in Public Speaking and English of a technical nature.

There is no need for a foreign language requirement in the College of Engineering.

In view of the occupations in which many of the graduates are employed, and their comments, it would seem advisable to consider the possibilities of initiating a program leading to a General Engineering Degree in the College of Engineering.

There appears to be a definite trend in engineering practice for greater emphasis upon fundamentals of drawing theory and projection, problem solving, and freehand drawing.

There is a definite need for a unified course in drafting which will emphasize the more valuable units of Engineering Drawing and Descriptive Geometry.

In view of the comments and recommendations of the respondents, it appears that the changes being made in the program of the College of Engineering are in line with the needs of its graduates.

Closer professional liaison should be established and maintained with high schools and junior colleges in regard to pre-engineering preparation.

Faculty advisers should give careful consideration to the possible value of non-engineering courses and related engineering subject matter areas when planning programs in engineering.

Further adherence to industrial drafting practices might be gained through the study and execution of more Piping and Electrical Drawings, a study of Force Diagrams, and presentation of data through the use of graphs.

Microfilm $2.50; Xerox $8.40. 183 pages.

A SURVEY OF EDUCATION IN THE BELGIAN CONGO

(L. C. Card No. Mic 59-5340)

Malvin Earl Moore, Jr., Ed.D.
George Peabody College for Teachers, 1959

Major Professor: Clifton L. Hall

The purpose of this study is to give an account of education in the Congo and to make available pertinent information for those who would continue a study of education in Africa. Information was obtained from the Ministry of Education officials in Brussels, Belgium, and from teachers, students, educational administrators, business men, religious leaders, labor leaders, and citizens, European and African, in the Belgian Congo.

Findings of the Study

Education in the Congo is conducted by three agencies: the government, missions, and industrial companies. These agencies are aided by the works and gifts of philantropic organizations. Education is designed to raise the intellectual level of the black African and to improve his social, economic, and health status. It does not set out to prepare him for eventual self-government. Education is the means by which the Belgians intend to bring civilization to the primitive African in the Congo.

The Belgians have felt that a follow-up of the paternalistic concept, which is native to the Congolese, is a wise colonial policy for native government. Thus, they have stressed the important of economic freedom for the African before any consideration of political freedom. They have insisted that the black African should learn the meaning of work, and that he should become a good workman. Consequently, strong emphasis is placed on industrial education in the Congo.

The educational system is designed to satisfy needs of Belgian industries in the Congo for skilled laborers; the resources of the Congo make it one of the richest colonies in the world. The Belgians have not imported labor from other countries because they wish to keep the cost of production low. Only by maintaining a skilled labor force to exploit the wealth of the Congo, the Belgians concluded that they had the solution to the problem of high production cost.

There are no compulsory educational laws in the Belgian Congo, and there will not be any for a long time. Provisions are made for any African child who wishes to attend school. At the present time, there are not enough schools and teachers to provide adequately a good system of education for the numbers of students who are enrolled in the schools. For this reason, it would be unwise to make education in the Congo compulsory. The Belgians do not have sufficient funds to provide an educational system for the number of African students, and they have relied heavily on the missions and large companies to assist them.

African teachers in the Congo are underpaid and are constantly leaving the field for employment with large companies. Although they are unprepared for their role in the educational system, they are able to earn more money with companies. The Belgians have used African teachers to fill the gap created by Europeans leaving the teaching field to enter various industries.

The African cannot yet compete successfully with the European either as a teacher or as an industrial worker.

Graduates of the two universities will form a native élite. They will be doctors, lawyers, engineers, and priests. They will replace Europeans who now occupy many positions in the Belgain government. The Belginas hope that they will serve as leaders for the masses. Members of the élite reside in centres extra-coutumiers are Europeanized. It is believed that in a few years they will be accepted in European society.

By civilizing the African, Belgians hope to establish a permanent partnership between themselves and Africans which will make the Congo a great country. Belgians have brought a way of life to the Congolese which will uproot many traditions and will replace superstition.

Microfilm $2.85; Xerox $9.80. 217 pages.

A FOLLOW-UP OF SELECTED GRADUATES OF ALABAMA STATE COLLEGE

(L. C. Card No. Mic 59-5329)

William Pernell Smith, Jr., Ed.D.
Rutgers University, 1959

I. INTRODUCTION

Too often there is an attitude of finality when graduates leave college. Because they have completed the prescribed courses of study and no longer attend the college, they frequently are not remembered except when transcripts are requested, or when contributions are being solicited. Contrary to this practice, graduates should be observed in whatever they do, for information obtainable only through follow-up study is essential if the educational institution is to attain its maximum effectiveness.

II. STATEMENT OF PROBLEM

The purposes of this study were: (1) to ascertain the present socio-economic status of some of the graduates of the Alabama State College, Montgomery, Alabama; (2) to analyze in a prescribed manner the present provisions for higher education for Negroes by Alabama State College and the state of Alabama; and (3) to present implications relative to the future growth and development of programs of higher education at Alabama State College, and in Alabama.

III. TECHNIQUES USED AND SOURCES OF DATA

Descriptive-survey procedures were used in this study. Data were collected by means of questionnaires which were mailed to 420 members of six classes of graduates of the college, and by personal examination of pertinent, private, as well as public records, and other documents.

IV. CONCLUSIONS AND IMPLICATIONS

Conclusions. The vast majority of the graduates of Alabama State College have come from Alabama homes, have been awarded the degree of Bachelor of Science in Education, have remained in Alabama, and have entered the teaching profession.

The total number of bachelor's degrees in Education awarded by Alabama State College is nearing the total number of Negroes gainfully employed in all educational services in Alabama.

Negro college graduates in Alabama want and need additional education and/or training beyond the bachelor's degree.

Some advanced training which Negro college graduates want and need is not available to them in local state supported schools for Negroes, even though it is available in local state supported schools for whites.

Despite the United States Supreme Court rulings to the contrary, state supported institutions of higher education in Alabama have remained segregated and unequal, with Negroes receiving the lesser portion of the educational provisions.

Though the majority of students attend Alabama State College because the school and its curriculum are their choices, many attend the college largely because it is convenient and economical.

Students attending Alabama State College receive less counseling than they desire or need at both high school and college levels.

There is little official help from the college relative to job placement of its graduates.

The majority of students who attend Alabama State College reside in the school dormitories for at least a portion of the time during which they attend the college.

Much of the housing for students provided by the college is overcrowded and ill-equipped.

Graduates of Alabama State College have demonstrated unusual concern about the socio-political problems of the day by becoming active registered voters in spite of obstacles placed before them and other Negroes.

Implications. Guidance and personnel services at Alabama State College should be coordinated and expanded.

The provision of student housing at Alabama State College is an important adjunct to the academic program. Student housing should be inspirational, as well as educational.

Increased awareness of their "second class" citizenship status, and of the better things in life, along with more understanding of the legal processes by which to achieve "first class" citizenship has been fundamental in increasing the number of registered voters among the graduates of Alabama State College. Better education makes better citizens. This is as it should be, and should continue.

The potential contribution of Alabama State College to the state has not been realized. To the public, the college is still Alabama State "Teachers" College. Emphasis should be placed upon popularizing and expanding the programs of the college in fields other than education.

The state of Alabama is depriving itself of valuable services and income by failing to provide schools in which many Negroes may obtain the advanced training which is suited to their interests, needs, and abilities. This waste of human resources should be discontinued.

Microfilm $2.65; Xerox $9.20. 202 pages.

PROGRAMS FOR THE EDUCABLE PUPIL IN TRENTON, NEW JERSEY.

(L. C. Card No. Mic 59-5331)

Charles Edward Williams, Ed.D.
Rutgers University, 1959

Problem. This study examined the educational programs for mentally retarded pupils, classified as educable in the Trenton, New Jersey public schools, and made recommendations.

Importance of study. The Beadleston Acts of 1954 made it mandatory upon local boards of education to provide "suitable facilities and programs of education and training" for all educable children. As a result, Trenton expanded its existing program.

Procedures. Surveyed literature in the field of retardation; examined practices of local instructors and their reactions to their respective programs; described the local philosophy, administrative organization, administrator reactions; and reported pupil and parent reactions.

Findings. Seven per cent or 975 pupils of Trenton's public school population were enrolled in educable classes.

Although sixty-three per cent or forty instructors were

not fully certified, nevertheless, as a group, these teachers had an overall average of five years experience in teaching the retarded child.

No specialized guidance personnel services were available for educable pupils at the elementary level, the guidance function being the sole responsibility of the teacher of educable pupils.

Specialized guidance services such as testing and counseling were provided for at the senior high school level, although a placement service was not included.

Although Trenton has the oldest public school program in the state for retarded children, nevertheless the existing building facilities and the available curriculum materials and supplies were considered inadequate at the junior high school level.

Conclusion. The program has had strong administrative support and general community acceptance. In spite of existing inadequacies, the program has received overwhelming endorsement of parents interviewed in the study. In addition, interviews with the pupils appeared to substantiate the observation that the stated objectives of the program were being satisfactorily achieved.

Recommendations. Expansion of the guidance program to include work experience, placement, and follow-up services at the senior high school level would aid in the implementation of the philosophy and objectives of the program for educable pupils.

Survey of work experience programs for educable pupils on a senior high school level with the objective of initiating such services at the Trenton Central High School.

Microfilm $3.90; Xerox $13.20. 301 pages.

EDUCATION, ADMINISTRATION

AN EVALUATION OF THE PHILOSOPHY, ROLE, AND FUNCTION OF AN INSTITUTION OF HIGHER LEARNING IN A COOPERATIVE APPROACH TOWARD INSTRUCTIONAL IMPROVEMENT WITH FIFTEEN ALABAMA COUNTIES.

(L. C. Card No. Mic 59-5270)

Louis Cleveland Alderman, Jr., Ed.D.
Alabama Polytechnic Institute, 1959

Supervisor: Truman M. Pierce

The purpose of this study was (1) to appraise the approach of the School of Education at Alabama Polytechnic Institute in a cooperative program for instructional improvement with fifteen Alabama counties in terms of the philosophy, role, and function of a land-grant institution and (2) to project direction for further service of the School of Education in view of the changing scene. Five steps were undertaken to achieve that purpose:

1. The philosophy, role, and function of a land-grant institution with emphasis on interpretations at Alabama Polytechnic Institute were described.
2. Certain basic principles were identified and criteria developed by which an evaluation was made of the cooperative approach to instructional improvement in terms of the philosophy, role, and function of a land-grant institution.
3. Major elements of the cooperative approach toward instructional improvement were described and analyzed.
4. The cooperative approach toward instructional improvement was evaluated by application of criteria formulated.
5. Projections for further service and recommendations for improvement in the cooperative approach toward instructional improvement were made.

The more significant findings of the study were:

1. The cooperative approach toward instructional improvement with fifteen Alabama counties was a successful venture by the School of Education of Alabama Polytechnic Institute in terms of the philosophy, role, and function of a land-grant college.
2. It provided new opportunities for professional growth of teachers, administrators, staff members, and advanced graduate students.
3. It provided unique means for assisting school systems in organizing and conducting system-wide programs of instructional improvement through (a) the scientific method of problem-solving, (b) the cooperative use of the method of intelligence, (c) the liberal and practical approach through utilization of summer work conferences and field laboratory courses, and (d) the development of research studies and experimentation.
4. It provided for development of new relationships among the functions of teaching, research, and extension, blending them into a unique pattern for meeting the changing needs of local school systems; and for integration of the various elements of extended field services--the field laboratory program, summer workshops, use of consultants, short courses, research studies, use of mass media of communication, and the in-service training programs within each county--into a comprehensive program for the professional growth and development of all school personnel.
5. It provided for further development of democratic educational leadership and assisted Alabama Polytechnic Institute in further carrying out its obligations to the state by attracting greater numbers of people from wide areas of the state.

The most significant recommendations were:

1. The summer work conferences in administrative leadership and guidance should be continued and expanded to include other areas such as science, mathematics, modern foreign languages, English, social studies, and library science.
2. The field laboratory program should be continued and expanded to include other geographic areas and in terms of additional graduate and undergraduate courses.
3. Field laboratory courses should be offered for the duration of an academic year with the addition of

problems courses designed to augment and succeed the foundation courses.

4. Research studies to determine further effectiveness of field laboratory courses should be conducted and additional avenues explored for projection of some innovative form of the field laboratory approach.
5. Individual faculty members should be designated as consultants to work with school systems during an entire year with additional resources of the School of Education made easily available for implementing programs of instructional improvement.
6. Short intensive courses for administrators, board members, and in-service planning committees should be offered.
7. Research studies should be broadened to include more counties and should include development of more effective evaluation instruments.
8. Extended services of the School of Education should be integrated with in-service education programs in each county into a closer relationship to achieve a common unified approach toward instructional improvement within each school system.
9. The potential of educational television should be utilized to the fullest, tested by research, and coordinated with the field laboratory program, the in-service education programs within the local counties, and the other field services of the School of Education.
10. Further investigation should be undertaken concerning the use of additional technological advances in classroom teaching.
11. Investigation should be made concerning availability of various local, state, and national agencies in provision of additional resources for further cooperative efforts toward instructional improvement.
12. Other resources of the institution, such as those provided by an interdisciplinary approach, should be utilized in further cooperative efforts toward instructional improvement.

Microfilm $3.70; Xerox $12.40. 285 pages.

PERSONALITY RIGIDITY, PATTERNS OF OPERATION, AND LEADERSHIP EFFECTIVENESS OF SECONDARY SCHOOL PRINCIPALS.

(L. C. Card No. Mic 59-6086)

Benjamin Hasting Bailey, Ed.D.
The University of Florida, 1959

This study of the leadership behavior and personality rigidity of 40 secondary school principals was concerned with two sets of relationships: (1) The relationships existing between the descriptions of leader behavior obtained by the administration of the Leader Behavior Description Questionnaire (LBDQ) and the descriptions of leader behavior obtained by the administration of the Principal Behavior Check List--Greatest Difference Form (PBCL--GD); and (2) the relationships between personality rigidity of secondary school principals and aspects of their behavior as leaders of their school faculties.

The hypotheses which were examined in this study were:

1. There are no significant relationships between the leadership effectiveness of school principals, as measured by the Leader Behavior Description Questionnaire, and their patterns of operation, as measured by the Principal Behavior Check List--Greatest Difference Form.
2. Principals who are high in effectiveness, as measured by the Leader Behavior Description Questionnaire, display a moderate degree of personality rigidity, as measured by Rehfisch's Personality Rigidity Scale.
3. There are no significant relationships between principals' patterns of operation, as measured by the Principal Behavior Check List, and their personality rigidity, as measured by Rehfisch's Personality Rigidity Scale.

Data for the study were obtained in the following manner: (1) The Principal Behavior Check List and Rehfisch's Personality Rigidity Scale were administered to 40 secondary school principals in three Florida counties; and (2) the Principal Behavior Check List and the Leader Behavior Description Questionnaire were administered to five teachers selected from among the faculty members of each of the schools represented in the study.

When the data were processed and analyzed, the first hypothesis was sustained, the second hypothesis was rejected, and the third hypothesis was sustained. Therefore, the conclusions were:

1. Although they each may be valid measures of leader behavior, within their respective frames of reference, the Principal Behavior Check List and the Leader Behavior Description Questionnaire apparently measure two different dimensions of leader behavior.
2. Personality rigidity and leader effectiveness, as measured and defined in this study, are not related.
3. Personality rigidity, as measured by Rehfisch's Personality Rigidity Scale, is not significantly related to the pattern of operation of a secondary school principal, as measured by the Principal Behavior Check List.

Microfilm $2.50; Xerox $6.20. 126 pages.

A CRITICAL ANALYSIS OF ADMINISTRATIVE STAFFING NEEDS OF JUNIOR COLLEGES

(L. C. Card No. Mic 59-6698)

Edwin Curry Boynton, Ed.D.
The University of Texas, 1959

Supervisor: Dr. C. C. Colvert

Junior college growth has been tremendous in the past fifty years. Because of its rapid development, administrative organization and costs have lacked consistency among institutions of the same kind and size. The purpose of this study was to investigate thoroughly these practices and to make recommendations for their improvement.

Literature revealed the following information on administrative design at the junior college level: Span of control should be limited to a president and five

subordinates. When size makes this impractical, reorganization of structure must take place. All administrators must know their specific responsibilities. The registrar, director of students, librarian, business manager, and dean were considered by one writer as mandatory for any junior college regardless of size.

Cost studies have been directed primarily at the total product, and not just to administration. Size was found to have a definite bearing in one study on percentage of administrative expenses. A most recent investigation found a breaking point here at a point of approximately 300 students.

Data were gathered through questionnaires sent to 332 public and private junior colleges throughout the United States. A 56.9 per cent return resulted. Information was recorded by using a break-down of six enrollment brackets.

The population of the junior college district was found to bear significantly on size of the public institution, but showed little relationship to size of the private colleges. The smallest public colleges reported a president, business manager, dean, and registrar or a combination of these last two. Additional personnel were added at each of the six enrollment intervals. Private junior colleges began with a president, business manager, dean, registrar, and either a dean of women, director of public relations, or a librarian on a part-time basis. Additional men were added at four enrollment intervals. Throughout the investigation, private institutions tended toward larger administrative staffs than public colleges.

Administrative costs were found to decline rapidly in public junior colleges of above 1200 students. After a slight rise in costs to a point of 599 students, this same reduction is also evident in the percentage that administration is of total educational cost. National medians indicate a consistently higher cost for private colleges. In these schools, median dollar expenditures take a sharp drop between the 0-299 and 300-599 intervals, and then tend to rise quickly with enrollments of 600 or more.

In addition to data received from each institution, thirty men of note in junior college education were written and sent a check-list in which they were asked to comment on these administrative and cost problems. Also visits were made to selected public and private junior colleges in Texas within each enrollment bracket. The purpose of the data from both these sources was to gain additional theoretical insight into the problem, and to verify results obtained from the colleges.

Recommendations include:

1. An administrative span of control of no more than five men.
2. Frequent revision of organizational framework.
3. Long-term financial planning in both types of colleges.
4. A public junior college should have at least 30,000 people in its district.
5. First administrative expansion should come between 300 and 450 students, depending on local needs.
6. A beginning administrative term in public institution should consist of a president, dean, registrar, business manager. The dean and registrar should be separated in the private colleges.
7. Administrative expenses of above 40.0 per cent cannot be justified in private junior colleges.

Microfilm $2.50; Xerox $8.80. 192 pages.

THE PRACTICES OF OKLAHOMA SCHOOL BOARDS IN THE INSURING OF SCHOOL DISTRICT PHYSICAL PROPERTY

(L. C. Card No. Mic 59-5487)

Paul Leslie Brent, Ed.D.
University of Oklahoma, 1959

Major Professor: Claude Kelley

The problem of this study was to survey the practices of Oklahoma school boards in the insuring of school district property and to determine how these practices might be modified to provide greater protection and economy.

Property insurance practices of Oklahoma school boards were determined by means of a questionnaire sent to the 500 districts in the state maintaining high schools. These districts were divided into four groups in order to determine if differences existed in insurance practices in various sized districts. Completed questionnaires were received from 272 or 46.1 per cent of the districts. The practices of Oklahoma schools were compared with criteria for an ideal school property insurance program and insurance practices of schools over the nation. The premium-loss ratio was determined for Oklahoma public schools.

Conclusions based on the findings are as follows:

1. It seems that the property insurance affairs of many Oklahoma school districts are poorly managed. This is probably due to a combination of the following factors: (a) school administrators lack information about insurance and have no easily accessible place outside the insurance industry to obtain such information, (b) school administrators have insufficient time to properly attend to all phases of school business administration, and (c) school authorities appear to seek to maintain the good will of local insurance agents regardless of possible consequences to the district.
2. A factor contributing to the high fire insurance premium-loss ratio in Oklahoma schools is lack of frequent, properly conducted fire prevention inspections by competent, trained personnel.
3. In general, the practices of the larger Oklahoma school districts conform more closely to the criteria for an adequate school property insurance program than do the practices of the smaller school districts.

Suggestions for modification of practices include:

1. Appraisals should be made on a business-like basis at least every two years, preferably by competent commercial appraisal firms.
2. Schools should remove as many penalty-causing hazards as practical through minor alterations and better housekeeping, then call for a reinspection to see if rates can be reduced.
3. Schools using coinsurance must maintain the required amount of insurance. Those that cannot afford this much insurance should not use coinsurance.
4. Schools should set up objective plans for selecting agents, insurance companies, and distribution of business to agents.
5. School districts and the State Board of Education should provide in-service training for personnel making fire inspections.
6. The State Board of Education should make available information needed for making accurate appraisals.
7. A state program of school insurance, such as the one described in the study, should be inaugurated.

Microfilm $3.20; Xerox $11.00. 248 pages.

A CRITICAL ANALYSIS OF THE FINANCIAL PLANNING, RECORD KEEPING AND REPORTING, AND FINANCIAL NEEDS OF SELECTED KANSAS PUBLIC JUNIOR COLLEGES.

(L. C. Card No. Mic 59-6702)

Ellsworth Reese Briggs, Ph.D.
The University of Texas, 1959

Supervisor: James W. Reynolds

This thesis reports an intensive study of the financial practices and needs of Kansas public junior colleges at Hutchinson, El Dorado and Pratt. Its purpose was to seek improvements for these representative junior colleges with perhaps wider implications.

The methods involved were:

(1) showing the need for improvement in financial reports of the fourteen Kansas public junior college superintendents and by their responses to a questionnaire.

(2) tracing movements for uniformity in accounting and reporting for colleges and universities and for public schools since many junior colleges report on both bases.

(3) on-the-spot studies of financial practices in and for the three junior colleges.

(4) analyzing junior college report forms from the ten states requiring them and from national agencies.

(5) conferring with state officials regarding possible improvements.

(6) projecting enrollments and building needs to determine the adequacy of income sources and to make recommendations.

The study found deans becoming increasingly active in employing staff and by faculty action defining the educational program and its needs. In all three school systems machine accounting has been recently installed with departures from state-required accounting approved by the State Accountant. Yet the mandatory accounting, published budgets and reports inadequately reveal the junior college operation. Activity accounting was judged satisfactory, despite questions by one official.

Kansas reporting, except for deficiencies in revenue reporting, was ranked among the best, but the extent of data collected obligates the state agency to make greater use of it. Incomparability of Texas and Colorado expenditure reporting with that of the other eight states, required an attempt to harmonize public school and college and university accounting differences. After presentation also of national report forms, it was concluded the two systems are not readily comparable.

State officials revealed interest in and support of junior colleges and cited precedents for needed fund transfer. But state leadership for improving accounting and reporting is lacking. Junior college financial problems in Washington State were presented. The U.S. Office of Education Financial Accounting for Local and State School Systems, Handbook II was recommended for state-wide use. A Junior College Fund was proposed into which all revenues would be receipted and from which as many junior college expenditures as possible would be made. Legal authorization to transfer money from the General Fund to this fund would be necessary. All allocable expenditures would be charged direct to the fund; a teacher-time-salary total for junior college would be divided by the school system total to secure a "decimal multiple" to prorate at the end of the year costs shared with the high school or other levels. A separate junior college budget derived by faculty action and separation in the published budget and annual report were shown to be necessary.

Examination of finance laws and taxes indicated sources were inadequate to provide the educational program and buildings needed for enrollments predicted to 1974. This was true even of the two junior colleges whose counties voted in 1958 to help support them. By adapting national norms, costs of buildings and programs were calculated for junior colleges of 500 and 1,500 students. National studies were cited to show means of support elsewhere.

The study concludes with recommendations for: widening the tax base to the county, increasing adjoining county tax transfers to full operational costs and a building use fee, securing state aid for educational program and buildings, the convening of state conferences to achieve accounting and reporting uniformity for Kansas public junior colleges through use of Handbook II, and requesting national conferences to compromise differences between accounting and reporting of colleges and universities and public schools to make meaningful and comparable the financial reports of junior colleges.

Microfilm $4.30; Xerox $14.40. 335 pages.

A STUDY OF FACTORS RELATED TO EDUCATIONAL OPPORTUNITIES IN WISCONSIN WITH SPECIAL REFERENCE TO THE UNIVERSITY OF WISCONSIN EXTENSION CENTERS

(L. C. Card No. Mic 59-6973)

Milton Eric Carlson, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor LeRoy J. Peterson

THE PROBLEM

This investigation was made in a setting of increased efforts and needs to equalize higher educational opportunities in Wisconsin. An important phase in equalization of collegiate educational opportunity is related to availability. Therefore, the first phase of the investigation was concerned with a study of collegiate availability in the state.

Since the University of Wisconsin Extension Centers have the objective of making the first year or two of collegiate education more readily available in communities of the state, the desirability of utilizing Extension Centers is dependent in large part upon the academic achievements of its students as they transfer to a four-year collegiate institution. Thus the second phase of this investigation was concerned with a comparison of performance of Center students at the Center with later performance at other colleges and universities. Also, since the Extension Centers are considered as extensions of the University of Wisconsin into the state, a comparative study was made

between the performance of Extension Center students and Madison campus students.

PROCEDURE

A map of Wisconsin was divided into sections of geographic areas, and a circle of twenty-mile radius was drawn around each existing collegiate institution. Tuition charges and percentage of home-county high school graduates who attended the local collegiate institution were considered in examining service to the local geographic area.

For the study on University of Wisconsin Extension Centers, the entire group of 1950 full-time beginning freshmen at the eight Extension Centers was used. This entire group of Center students and a randomly selected group of 1950 Madison campus students were utilized in the comparative study.

FINDINGS AND CONCLUSIONS

1. A large portion of the total geographic area of the state of Wisconsin lies outside the areas included within the circles of twenty-mile radii drawn around each of the existing collegiate institutions.

2. Some of the existing collegiate educational institutions serve only a small portion of the total number of high school graduates in the geographic area in which they are located. A relationship was found to exist between the percentage of home-county college freshmen who attended the local collegiate institutions and the amount of tuition charged.

3. In general, both male and female Center students receive higher gradepoint averages at collegiate institutions attended after leaving the University of Wisconsin Extension Centers than they received at the Centers. (This conclusion excludes Center students transferring to the University of Wisconsin, Madison Campus.) It was found that both male and female students had higher median and mean gradepoint averages at each of the following classifications of collegiate institutions attended after leaving the University of Wisconsin Extension Centers than they received at the Centers: Wisconsin State Colleges, Universities other than the University of Wisconsin and Colleges outside Wisconsin. Higher median and mean gradepoint averages were also attained by Center males who later transferred to private colleges in Wisconsin, while females received approximately the same median and mean gradepoint averages at both the Centers and Wisconsin private colleges.

4. In general, there are no differences in academic achievement, as measured by mean gradepoint averages, of freshman students who begin their college education at one of the Centers and later transfer to the University of Wisconsin, Madison campus, and of freshman students who begin their college education at the University of Wisconsin, Madison campus, and continue at the university for a period of time comparable to the total time which Center students attended the Centers and the Madison campus. Out of a total of 83 comparisons made between groups of Center students and Madison campus students, with groupings based wholly or partially on sex, 11 showed a significant difference at the 5% level of significance.

Microfilm $2.90; Xerox $10.00. 222 pages.

LAY COMMITTEE ACTIVITIES IN PUBLIC SCHOOL DISTRICTS IN NEW JERSEY

(L. C. Card No. Mic 59-5320)

William J. Cravatts, Ed.D.
Rutgers University, 1959

1. Statement of the Problem

This project was designed to study lay committee activities in public school districts in New Jersey. It had three purposes: (1) to learn the purposes for which committees have been established; (2) to describe the practices followed in the initiation, organization, and operation of committees; and (3) to develop recommendations for initiating, organizing, and operating lay committees in public school districts generally.

2. Procedure

The descriptive-survey method was used in the study, the data being collected by means of questionnaires and interviews. Sixty carefully trained interviewers, working in pairs, conducted interviews with school administrators and lay committee chairmen in seventy-eight representative school districts in which committees had been active at some time since the beginning of 1953.

3. Findings

The study revealed that committees have worked successfully on many different kinds of problems involving school building needs, educational programs, and school-community relations. Building needs have been the major preoccupation of committees but there were definite indications that lay participation in the area of curriculum is increasing. The study revealed further that successful committees have been initiated and organized and have operated in many different ways and combinations of ways, and that there is no single pattern which spells success.

4. Conclusions

The experiences of the committees surveyed in the study indicate that the effectiveness of committees seems to be enhanced when:

(1) The committee works on a real problem. Lay persons who propose the formation of a committee and wish the support and cooperation of school officials must be prepared to explain to the officials exactly what it is they expect the committee to accomplish.

(2) Sponsorhsip of the committee is accepted by the board of education. This sponsorship will help assure the committee of the support and cooperation of the school officials, without which, experience indicates, it is difficult for a lay committee to work effectively.

(3) The committee's membership contains a wide cross-sectional representation of the community. This representation can be secured by requesting community organizations to name representatives, extending invitations to selected individuals, and extending an open invitation to the general public for volunteers. However, if the problem to be studied is a technical one, it may be more important to select members on the basis of their special skills and knowledge than to have community representation.

(4) The committee receives a thorough orientation to the problem and a clear description of the committee's purpose, scope, responsibilities, and authority. A written outline containing this information will help to prevent

subsequent misunderstandings among the committee members and between the members and school officials.

(5) The committee has able officers, the chairman especially, and is free to determine its own organizational pattern and method of operation. It is desirable that the officers be lay people, preferably chosen by the committee members rather than appointed by school officials. If the committee is large and/or the problem involved is complex, the use of sub-committees will facilitate the committee's work.

(6) School board members, the school administrator, and school personnel are available to the committee as consultants and resource persons.

(7) The committee has a good public relations program. It is preferable for this program to be the responsibility of the committee rather than of the school officials.

(8) The committee agrees on a single set of recommendations. However, in the event that this is not possible, it is better to develop alternate recommendations with a listing of the pros and cons of each than to make majority and minority reports.

(9) The committee submits its findings, conclusions, and recommendations in writing directly to the board of education. After deciding on the action it will take on the recommendations, the board should explain its decisions to the committee and then dismiss the committee if it was a temporary one or place it on a stand-by basis if it was a continuing one.

Microfilm $3.10; Xerox $10.60. 238 pages.

SCHOOL DISTRICT REORGANIZATION: FEASIBILITY OF METHODS FOR LOCATING BOUNDARY LINES OF SOCIOLOGICAL TRADE AREA COMMUNITIES.

(L. C. Card No. Mic 59-6699)

Daniel Troy Craver, Ed.D.
The University of Texas, 1959

Supervisor: Kenneth E. McIntyre

The subject of this study consists of a problem within the major problem area of school district reorganization. Authorities in the field have consistently stated that sociological trade area communities which provide on a day-to-day week-to-week basis most of man's essential goods and services are a logical foundation on which to reorganize local school districts. Thus, on this assumption the feasibility of methods for locating the boundary lines of such communities is important.

This study consists of (1) determining the basic considerations inherent in effectively organized school districts and (2) testing in terms of feasibility the known methods of delineating the boundary lines of the sociological secondary trade area communities which meet the standard of basic considerations. Five basic considerations were found to be inherent in affectively organized early Colonial school districts. These same considerations are found to be essential today. The five considerations are: (1) the sociological, cohesive self-sufficient community; (2) curriculum and services to meet the needs of all children and youth in the prevailing social order; (3) accessibility of the school to the pupil; (4) an equitable tax base for local support; and (5) economy in terms of human and economic resources.

Four methods for locating the boundary lines of secondary trade area communities were each tested in five widely differing situations in Texas to determine the feasibility of each method for use in a large-area broad-scale school district reorganization program which would involve many kinds of situations. Each method was systematically applied in each of five trade area communities, and each method was tested against the criteria of (1) cost in time; (2) cost in money; (3) susceptibility to willful distortion, causing tension or furor; and (4) goodness of fit of the boundary line delineated according to the accepted standard (the fringe area survey method).

As a result of the study it was found that for delineating the boundary lines of sociological secondary trade area communities in a broad-scale large-area school district reorganization program:

1. the fringe area survey method is:
   (a) the most reliable;
   (b) no willful distortion was indicated nor tensions or furor created;
   (c) probably would be the least expensive in time; and
   (d) probably would be the least expensive in money.
2. The formula method is valuable for preliminary surveying and planning for a wide-area large-scale program, but not reliable enough for final determination of boundary lines for school districts at the local level. It is
   (a) least expensive in time;
   (b) least expensive in money;
   (c) not susceptible to willful distortion, tensions or furor; and
   (d) unreliable for final determination of local school districts.
3. The trade center interview method would not be very practical for the purposes of wide-area large-scale school district reorganization; however, it ranked
   (a) second in goodness of fit;
   (b) is expensive in cost in money;
   (c) expensive in time; and
   (d) has a tendency to over estimate the outer limits of the community.
4. The pupil questionnaire method is
   (a) least reliable in terms of goodness of fit;
   (b) the most expensive in terms of time;
   (c) the most expensive in cost in money; and
   (d) the most susceptible to willful distortion, creating tensions, and furor.

The information obtained by the study should prove very useful in a state-wide program of school district reorganization.

Microfilm $3.35; Xerox $11.40. 258 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

A CASE STUDY OF DESEGREGATION IN THE PUBLIC SCHOOLS OF TRENTON, NEW JERSEY

(L. C. Card No. Mic 59-5321)

Roland Howard Daniels, Ed.D.
Rutgers University, 1959

Introduction

The momentous Supreme Court decisions on segregation in public education of May 17, 1954 and May 31, 1955, suggest that school boards and communities throughout the country will need to search for effective methods for meeting the administrative problems arising from these decisions.

On the 17th of February, 1944, the Trenton, New Jersey Board of Education was served a Writ of Mandamus issued by the New Jersey Supreme Court demanding that the Trenton Board of Education admit two Negro pupils to the junior school in their attendance area instead of a junior school established solely for Negro pupils and teachers. This order from the New Jersey State Supreme Court brought about the end to a long established custom of segregating Negro public school pupils in grades seven, eight and nine.

Problem

The purpose of this study was to show how the Trenton, New Jersey Board of Education accomplished the desegregating of its public school system. It was not the purpose of this study to determine the success of desegregation in terms of academic achievement or pupil adjustment but rather to pursue the following objectives:

A. To identify the administrative problems and policy decisions which affected desegregation in the public schools of Trenton, New Jersey.

B. To trace the development and reactions to these decisions on the part of the community of Trenton, New Jersey.

C. To analyze critically the ways in which the policy decisions were implemented.

D. To suggest effective methods of meeting administrative problems dealing with desegregation in the public schools.

Procedure

Data for this study were secured through:

A. Survey of literature on the topic.

B. Interviews with selected personnel in the public schools of Trenton, New Jersey who were in continuous employment before and after integration of the public schools.

C. Examination of records of the court actions to desegregate the public schools of Trenton, New Jersey.

D. News articles appearing in local newspapers.

E. Interviews with individuals in the community involved in the problem.

F. Examination of the files and records of the organizations in the community involved in the desegregation of the schools.

G. Examination of the files and records of the Trenton, New Jersey Board of Education.

Summary of Findings

A. Following the court decision, no immediate action was taken by the Board.

B. A few selected Negro teachers were transferred the first year of desegregation.

C. Protests of white parents to desegregation resulted in modified action for "one year only."

D. Desegregation produced a minimum of racial conflict.

Conclusions

The study presents the following conclusions:

A. The local school authorities should decide on a plan for making integration work according to local conditions.

B. Once the decision has been made to desegregate and the plan released, the school authorities should act with unanimity in handling any deviations from its policy.

C. The school authorities should utilize the agencies within the community to aid and assist in its program of desegregation.

D. All efforts should be made to have similar curriculum offerings (in schools of the same type) so that no objections will be made on the grounds that attendance at a particular school will provide an inferior education.

E. The assignment of pupils to schools should be made on the basis of the attendance area established for each school.

F. The Board should constantly aid and assist the staff in adjusting to the changed situation.

G. Teachers should be employed without regard to race, color or creed.

H. There is need for constant evaluation of the plan of desegregation so that adjustments may be made when necessary in order to insure the success of the program.

Microfilm $2.50; Xerox $8.40. 181 pages.

AN ANALYSIS OF PERSONNEL PRACTICES IN SELECTED SCHOOL SYSTEMS OF THE SOUTHWEST REGION

(L. C. Card No. Mic 59-5489)

Roy Merwin Deever, Ed.D.
University of Oklahoma, 1959

Major Professor: Dr. Claude Kelley

This study was designed to present information concerning personnel practices in school systems employing 100 or more teachers in the Southwest Region which includes the states of Arkansas, Colorado, New Mexico, Oklahoma, and Texas. The purpose of the study were:

1. To discover the existing personnel practices relative to (a) formulation, revision, and publicity of personnel policies; (b) assignment, transfer, and promotion of staff; (c) leaves of absence; and (d) separation from service.

2. To compare these personnel practices with the judgments of the superintendents concerning their value and with the principles and practices that are presented in the literature.

3. To identify the areas of personnel administration in which the practices materially affect teacher morale.

Data were obtained from 107 questionnaires which were received in response to requests sent to 176 superintendents in the Southwest Region. Other data were obtained from 507 questionnaires received from classroom teachers in the selected school systems. Questionnaire responses were tabulated and analyzed to determine the prevalence of certain personnel practices and the superintendents' value judgments of them in the 107 cooperating school systems.

Conclusions:

1. Although there are some areas in which improvement ment is definitely needed, the personnel practices in use in the Southwest Region are reasonably sound.

2. The official personnel policies of many schools cover only limited areas of personnel administration.

3. Reasonably good provisions are made for short-term professional leave but provision for extended professional leave are very inadequate; relatively few administrators recognize the value of sabbatical leave.

4. The most important personnel areas in the improvement of morale according to teachers are: (a) salaries and salary scheduling; (b) academic freedom and tenure; and (c) selection and orientation of the teaching staff. Those which weaken morale are: (a) assignments, transfers, and promotions; (b) separation from service; and (c) in-service education. There is considerable misunderstanding among superintendents relative to the personnel practices which improve teacher morale and those which weaken teacher morale.

5. In general a greater percentage of superintendents recognize the importance of many personnel practices than have these practices in operation in their schools.

Recommendations:

1. Personnel administration should be based upon wri..ten policies which are formulated by cooperative participation of the board of education, the superintendent, other administrative personnel, classroom teachers, and lay citizens.

2. Personnel administration must vigorously protect the rights of professional, competent teachers in the matter of dismissal and must also judiciously eliminate those teachers who are unfit for service.

3. The teaching profession through state associations, legislative enactment, and state and local leadership should put forth concerted effort to make adequate provision for extended leave for professional study.

4. It is recommended that superintendents periodically examine with the staff those personnel practices which are of greatest importance to teacher morale.

Microfilm $2.85; Xerox $9.80. 220 pages.

A STUDY OF THE IN-SERVICE EDUCATIONAL NEEDS OF THE COUNTY SCHOOL SUPERINTENDENTS IN GEORGIA

(L. C. Card No. Mic 59-5681)

Harold Nathan Dennis, Ed.D.
University of Georgia, 1959

Supervisor: Dr. John A. Dotson

Purpose and Scope of the Problem

The purpose of this study was threefold: (1) to determine the specific knowledges and skills needed by county school superintendents in the performance of their jobs, (2) to determine to what degree the county school superintendents in Georgia possess these knowledges and skills, and (3) to make recommendations for the in-service education of the county school superintendents in Georgia consistent with and based upon the findings of this study. All county school superintendents in Georgia were included in the study.

Methods and Procedures

A checklist-questionnaire, "The Superintendent's Profile," was developed and validated. This questionnaire consisted of eighty specific knowledges and skills essential to the performance of the duties of a school superintendent. A copy of "The Superintendent's Profile" was given to each county superintendent in Georgia as a self-evaluation instrument. The same instrument was sent to 155 principals. The principals were asked to evaluate their superintendents on the instruments. A 73 per cent return was obtained from the superintendents, and a 66 per cent return was obtained from the principals. The research method was the survey-appraisal type. Statistical treatment included the use of rank order correlation, and the Null Hypothesis.

Summary of Findings

The eighty knowledges and skills were placed in eight major categories. Analysis of the data obtained from the self-evaluation by superintendents showed the rank order of help needed to be (1) instruction and curriculum development, (2) pupil personnel, (3) community-school leadership, (4) staff personnel, (5) school plant, (6) school transportation, (7) organization and structure, and (8) school finance and business management. A rank order correlation of .86 was found between self-evaluations by the superintendents and the ratings by principals. The rated possession of desirable knowledges and skills varied according to the eight major categories and according to individual knowledges and skills within the major categories. The rated possession of knowledges and skills was related to the educational background of the superintendents being rated. No significant difference existed between the ratings received by superintendents from the largest and those from the smallest county systems in Georgia.

Microfilm $2.50; Xerox $7.40. 159 pages.

A STUDY OF QUESTIONNAIRE RESPONSES FROM 5703 KANSAS HIGH SCHOOL PARTICIPANTS AND NON-PARTICIPANTS IN THE NATIONAL MERIT SCHOLARSHIP QUALIFYING TEST PROGRAM

(L. C. Card No. Mic 59-6603)

A. W. Dirks, Ed.D.
University of Kansas, 1959

The purpose of this study was to analyze the questionnaire responses of Kansas high school participants in the National Merit Scholarship Qualifying Test Program, and a randomly selected group of non-tested participants. More specifically the purpose of the study was to compare similarities and differences in questionnaire responses in the following areas: (1) family and home environment, (2) future plans, (3) study habits and attitudes, and (4) high school experiences and programs. This study is a part of a University of Kansas General Research Project.[1]

About 7,000 Kansas high school students from 322 schools, public and parochial, took the National Merit Scholarship Qualifying Test as juniors in the spring of 1958. From this group about 5,700 students representing 214 high schools were studied through a questionnaire survey. The students included in the study were members of the graduating class of 1959. The design used for this descriptive study was to separate the data into two categories: (1) Merit Participants, those who took the test; and (2) Non-merit Participants, those who did not take the test. Further divisions were male, female, and total in both categories. In addition to the numerical tabulations, percentages were computed for the responses in accord with the above named divisions. Tables were constructed to correspond to each question and to facilitate quick comparison of percentage results.

The results of the study in the area of family and home environment favored the merit group with respect to level of education attained by parents, ability of parents to send their children to college, the desire of parents to have their children attend college, and the conditions within the home which are conducive to uninterrupted study.

The future plans of students differed somewhat. A majority of both groups indicated they planned to attend college. However, a greater percentage of the non-merit students, than the merit students, planned to enter vocations or were undecided as to future plans. About four out of five students replying planned to enter a Kansas college in September, 1959.

A higher percentage of the merit participants than non-merit participants responded to positive habits and attitudes such as: home study, persistence, and intellectual curiosity. The images generally held by the merit students, that are indicative of future success in college, were reported with greater frequencies and higher percentages than the responses reported by the non-merit students.

About nine out of ten students from both groups reported they had an inspirational teacher of recognized excellence in his or her field. Kansas high school youth reported they participated widely in extracurricular activities and considered their activities a valuable part of their education. The attitudes of merit students, in regard to their high school education, surpassed non-merit students when measured in terms of satisfaction. Merit students elected more semesters in English, mathematics, science, social studies than did the non-merit students. About one-half and two-thirds, of the merit and non-merit groups respectively, reported no training in foreign languages.

There was a consistent difference in percentage between the merit and non-merit student in the pattern of responses to questionnaire items. The responses of the merit participants were probably responses typical of the upper half of high school graduates. The responses of the non-merit participants were more typical of the average high school student. This descriptive study presented a broad view of Kansas high school youth. It is hoped that this study will contribute to a better understanding of youth and contribute to a strengthened program for high school students.

Microfilm $3.55; Xerox $12.40. 274 pages.

1. Kenneth E. Anderson. University of Kansas General Research Project, Number 4548-5570.

PERSONALITY RIGIDITY, PATTERNS OF OPERATION, AND LEADERSHIP EFFECTIVENESS OF ELEMENTARY SCHOOL PRINCIPALS.

(L. C. Card No. Mic 59-6099)

Harold Myron Harmes, Ed.D.
The University of Florida, 1959

Three approaches to the study of school leader behavior are: (1) the approach used at The Ohio State University which led to the development of the Leader Behavior Description Questionnaire; (2) the approach used at the University of Florida which led to the development of the Principal Behavior Check List; and (3) the study of various personality traits of leaders in efforts to determine what traits are universally and uniquely associated with successful leadership.

The Leader Behavior Description Questionnaire was designed to measure the degrees to which leaders initiate group structure and show consideration. It has been theorized by the developers of the instrument that leaders must do both to be effective.

The Principal Behavior Check List was designed to measure the degrees to which school principals behave in a democratic and authoritarian manner. Implicit in the development of the instrument was the assumption that democratic leader behavior is more successful in many respects than authoritarian leader behavior.

Prior to this study the personality rigidity of school leaders had not been assessed and compared with their effectiveness as leaders or their patterns of operation. The Rehfisch Rigidity Scale was designed to measure the personality syndrome of rigidity.

This study was concerned with the identification of relationships between personality rigidity, leadership effectiveness, and patterns of operation of elementary school principals. Measures of these three factors were obtained from the administration of the Leader Behavior Description Questionnaire, the Principal Behavior Check List, and the Rehfisch Rigidity Scale in 38 elementary school situations in three Florida counties.

Results of the administration of the instruments indicated that there were no significant relationships between

any of the factors which were studied. A parallel study which involved secondary school situations in the same three Florida counties yielded similar results.

Microfilm $2.50; Xerox $7.00. 146 pages.

AN EXAMINATION AND EVALUATION OF CONSULTATIVE SERVICES OF THE GEORGIA STATE DEPARTMENT OF EDUCATION: 1957, 1958.

(L. C. Card No. Mic 59-5682)

James Donald Hawk, Ed.D.
University of Georgia, 1959

Supervisor: Dr. John A. Dotson

Statement of the Problem

The problem of this study was to examine and evaluate the consultative services rendered by the Georgia State Department of Education during the calendar years nineteen hundred and fifty-seven (1957) and nineteen hundred and fifty-eight (1958).

Objectives of the Study

The objectives of the study were as follows:

1. To determine those consultative services Georgia school superintendents stated that they needed, and/or received from the State Department of Education, the manner in which the services were administered, and the value superintendents placed upon the services received.
2. To determine the personal and professional qualifications and requirements of Georgia school superintendents requesting services and state department of education personnel making the services available.
3. To make recommendations to the Georgia State Department of Education based on analysis of data collected.

Procedures

Data for testing the hypotheses of this study were obtained from recorded information at the State Department of Education, and questionnaires returned by Georgia school superintendents. Other findings were based on an examination of related literature, the Code of Georgia and Georgia school laws, and functions of the State Department of Education.

General Findings

1. The State Department of Education accepts provision of consultative services to school superintendents and school staffs as its responsibility.
2. Staff members of the State Department of Education interpret their responsibilities to be consultative or advisory rather than inspectoral. Local school superintendents recognized the responsibilities of the department in the same manner and indicated satisfaction with the department in this respect.
3. The organizational structure of the State Department of Education indicates an awareness of need for consultative service in all major areas of educational responsibility. The department is organized along similar lines to other state departments of education in the nation. It is modern and progressive within the confines of present legislation, and budgetary allowances.
4. Most staff members of the State Department of Education had educational experiences prior to joining the department. The average age of staff members in the department of education indicated chronological maturity.
5. Georgia school superintendents used consultative services. All responding superintendents utilized to a degree some service of the State Department of Education. The superintendents, through their expressed needs, indicated an awareness of services available to areas of school responsibility directly related to routine functioning of their own offices. Less awareness of services related to the curriculum was indicated.
6. The academic preparedness of superintendents, size and type of school system they represented, and years of administrative experience as superintendents did not affect the total areas of educational responsibility in which consultative services were needed. These factors did affect particular areas of educational responsibility.
7. Georgia school superintendents expect to need help in an increasing number of areas of curriculum planning or revision, and instruction during the next twelve months. Superintendents will continue to need help in the same areas of general educational responsibility.
8. State Department of Education staff members attempted to provide consultative service in all areas in which superintendents indicated a need for services.
9. Staff members of the State Department of Education were the primary source of consultative service for 63.3 per cent of the responding school superintendents.
10. Georgia school superintendents received consultative services primarily through routine visits, requested visits, and by correspondence. The amount of time consultants spent in routine and requested visits was sufficient for effective administration of services.
11. The majority of all services from the State Department of Education which were rated by school superintendents were rated to be of high value.
12. Services superintendents received from the State Department of Education which were rated to be of low value were not generally due to any deficiency on the part of staff members of the department. Instead, the cause for a low value rating was within the local system receiving the service.

Microfilm $2.95; Xerox $10.20. 226 pages.

A CRITICAL ANALYSIS OF THE PRE-SERVICE PREPARATION FOR MUSIC INSTRUCTORS IN PUBLIC JUNIOR COLLEGES

(L. C. Card No. Mic 59-6714)

Jack William Hudgins, Jr., Ph.D.
The University of Texas, 1959

Supervisor: Dr. C. C. Colvert

This study is an investigation and, as the title states, a critical analysis of the pre-service preparation of the music instructors in the public junior colleges of the United States. Data were gathered from 148 public junior college music instructors concerning personal qualifications, academic qualifications, professional qualifications, and teaching experience. Data were also gathered from twenty-four leading junior college administrators and consultants pertaining to the desired qualifications and pre-service preparation for junior college music instructors.

From an analysis of the data concerning the qualifications described above, an attempt was made to describe the public junior college music instructor. The typical music instructor of the public junior college was a man, held a master's degree, and had completed the equivalent of one year's work toward the doctor's degree. The panel of consultants felt that the master's degree plus thirty semester hours was the desirable minimum of academic work for this instructor.

The study revealed that there has been an active interest in improving the preparation of public junior college music instructors. The results of this investigation, when compared to earlier studies somewhat similar in nature, showed that the music instructors participating in this study have had more formal musical and educational training during the past few years than twenty years ago. The investigation revealed, however, a need for a specific course in the music education curriculum embracing the function and philosophy of the junior college music program. A course in the field of Junior College Education was found also to be needed. Courses in the humanities, social sciences, and philosophy were recommended by the panel of consultants to broaden the general education of the music instructor.

The data also revealed that the music instructors participating in the study were teaching music courses of the standard college curriculum, such as theory, music literature, applied music, composition, and music education. No evidence was found which indicated college instruction of courses in music recreation, community service, community music; music for the general student, and the like.

Microfilm $3.35; Xerox $11.40. 257 pages.

A STUDY OF THE CRITICAL TASKS PERFORMED BY NORTH CAROLINA SCHOOL SUPERINTENDENTS IN THE AREA OF PUBLIC SCHOOL ORGANIZATION AND STRUCTURE

(L. C. Card No. Mic 59-5568)

David John Middleton, Ph.D.
The University of North Carolina, 1959

Supervisor: Guy Berryman Phillips

This is one in a series of eight studies in the Project for the Improvement of the Training of School Administrators. The project is being undertaken at the School of Education of the University of North Carolina in connection with the Southern States Cooperative Program in Educational Administration.

The SSCPEA in 1955 issued a publication entitled Better Teaching in School Administration. In this publication eight operational areas were identified in school administration, one of them being organization and structure. The publication further described in general terms the tasks which school superintendents need to perform in each of the eight areas. It was the purpose of the current study to more completely identify the tasks in public school organization and structure which North Carolina superintendents need to perform and also to make recommendations concerning the essential pre-service and in-service training needs of North Carolina superintendents.

Five critical tasks performed by school superintendents in public school organization and structure were identified. These tasks were:

1. Developing a staff organization to implement the educational objectives.
2. Working with the board of education in the formulation of public school policy and plans.
3. Establishing working relationships with local, state, and federal agencies.
4. Designating appropriate operational units.
5. Organizing lay and professional groups for participation in educational planning.

Twenty-seven representative North Carolina school superintendents were selected and, through the use of a structured interview, they gave information concerning the activities they performed in the five tasks. The activities which the superintendents found important constitute a competency pattern for North Carolina superintendents in the area of organization and structure.

On the basis of findings of the study, seven recommendations were made to institutions in North Carolina which train school superintendents. Briefly stated, they are:

1. The activities which constitute the competency pattern for North Carolina superintendents in organization and structure should serve as a basis for selection of subject matter in organization and structure.
2. Legal aspects pertaining to organization and structure should be included in a college course devoted to the study of public school law.
3. Subject matter related to four of the tasks in organization and structure should be included in an introductory educational administration course. These four tasks are developing a staff, working with the school board, establishing relationships with other agencies, and designating appropriate operational units.

4. Subject matter related to the task of organizing lay and professional groups should be included in a college training course devoted to administrative leadership.

5. Representatives of the Department of Public Instruction and representatives of colleges training prospective superintendents should seriously consider together methods of instituting an internship program for prospective superintendents.

6. Training institutions should enlarge their in-service training programs for school administrators. Most careful attention should be given to helping superintendents develop effective leadership in the organization of lay and professional groups.

7. At the completion of all the eight studies in the Project for the Improvement of the Training of School Administrators, the findings should be reviewed and consolidated into a competency pattern designed specifically for educational administration in North Carolina.

Microfilm $2.50; Xerox $8.60. 187 pages.

VOCATIONAL EDUCATION FOR JUNIOR COLLEGE STUDENTS: A METHOD FOR ESTIMATING RELATIVE COURSE NEEDS.

(L. C. Card No. Mic 59-4418)

Daniel Brewer Milliken, Ph.D.
The Claremont Graduate School, 1958

This study is designed to develop and present a new procedure for the analysis, study and evaluation of any occupation as a possible subject for a vocational curriculum in California junior colleges. This new procedure is based upon two forms of an occupational model which utilize the theoretical aspects of a conceptual model, and provide a framework for the analysis of any occupation. The new procedure also proposes that relevant information gained by the analysis be collated into significant conclusions by the use of certain concept known as "Information Theory." Preliminary to the development and explanation of the new procedure, the report establishes the importance of vocational curricula among the California junior college functions, and documents the need for improved methods of course selection.

As a guide to the kind of information needed to improve evaluation and selection of vocational curricula, four basic questions about occupations are formulated as ultimate goals. (1) Is this occupation attractive to junior college students? (2) Is there sufficient societal need for trained persons in this occupation to warrant a vocational curriculum? (3) Is the local junior college able and competent to provide a satisfactory vocational curriculum for this occupation? (4) How much preliminary public participation and understanding is a prerequisite to the introduction of a vocational curriculum in this occupation? The presentation of the new procedure is followed by its application to three occupations. The findings are discussed, possible further research indicated, and conclusions listed.

Although the new methodology has apparent limitations, it does provide significant conclusions which can improve administrative decision-making in the selection of vocational curricula. Any junior college administrator who has vocational curricula under consideration will find it to his advantage to follow the methodology outlined in this thesis.

Microfilm $2.95; Xerox $10.20. 227 pages.

GUIDANCE SERVICES AND PRACTICES IN THE NEGRO SECONDARY SCHOOLS OF GEORGIA

(L. C. Card No. Mic 59-5497)

Carlton Harold Morse, Ed.D.
The University of Oklahoma, 1959

Major Professor: Claude Kelley

The primary purpose of this study was to survey the guidance program in the Negro high schools of Georgia and to make recommendations for improvement.

The normative survey type of research was used. A questionnaire was constructed on the basis of the guidance services listed in Section G of the Evaluative Criteria. The instrument was sent to the principals of Negro high schools listed in the Georgia Educational Directory, 1958-1959. Sixty-six percent of the 184 questionnaires were returned and the data analyzed.

The findings of the study revealed that guidance services were provided to some extent in all the schools, some of the schools had certified counselors, but in general, the supply was inadequate; cumulative records were kept by a majority of the schools, but the information recorded in them was often limited.

In general, the guidance programs showed weaknesses in the areas of program organization, provisions for adequate physical facilities, available literature, adequate time allowance, inservice education for teachers, and the extensiveness of the testing program.

On the basis of the findings it was concluded that there is a need for more qualified counselors, additional physical facilities and supplies, an improved testing program, an increased effort in collecting, recording, and using formation about pupils, and adequate time for the performance of guidance activities.

It is recommended that:

1. Specialized guidance training be made available to Negroes in state supported institutions of higher learning,
2. Guidance be given a status position in the educational program,
3. The formula for allocating teachers be revised so that counselors may be employed without reducing the number of other teachers,
4. More supervisory and consultative services be provided from the state level,
5. The state's testing and scoring services be improved,
6. Prospective teachers be encouraged to take more guidance courses, and
7. Adequate physical facilities and materials be provided. Microfilm $2.50; Xerox $6.80. 143 pages.

THE HISTORY AND DEVELOPMENT OF THE LONG-RANGE PLAN IN THE BELLEVUE SCHOOL DISTRICT

(L. C. Card No. Mic 59-6417)

Delbert G. Peterson, Ed.D.
State College of Washington, 1959

Supervisor: Dr. Zend B. Katterle

The purpose of this study was to determine the extent of development that has taken place on the long-range educational plans of the Bellevue, Washington, Public Schools. The long-range plan was developed by over 200 teachers, administrators, and lay citizens during the school year 1950-51. The plan was published as The Bellevue Story in 1951.[1]

An analysis was made of the extent of development of the recommendations contained in the long-range plan. The recommendations were classified and studied in five major areas:

1. Administration (Policies and Personnel)
2. Instructional Program
3. Proposed Building, Sites, and Service Areas
4. Utilization of School Facilities by the Community
5. Financial Projections and Support.

A questionnaire which had been administered in 1950 was re-administered in the present study to a representative sample of the residents of the Bellevue School District. The questionnaire was used in an attempt to evaluate similarities and differences of residential opinions and knowledge of facts concerning the Bellevue Schools in 1950 and again in 1958.

The sources of data were obtained through a thorough study of documents in the Bellevue School District which included school board minutes, administration staff minutes, Citizens' School Advisory Council minutes, Parent-Teacher minutes, teachers' handbooks, curriculum guides, board secretary's annual reports, treasurer's financial statements, the school director's policy handbook, newsletters, superintendents' bulletins, and the annual school budget. All the school records available from 1950 through 1958 were studied.

A brief survey of the literature of the history and development of school community planning in the United States is included in the study.

The history of the Bellevue School District has been one of rapid growth and development. In the ten years from 1940 to 1950 school enrollments increased from 803 to 1,950. The school enrollment in 1958 was 8,871. By 1968 the projected enrollment is 21,000.

It is apparent from evidence presented in the study that the Bellevue Citizens' School Advisory Council formed in 1950 has been effectively operating to improve the schools. A sound relationship has existed during the past nine years between the professional staff, the school board, and the Citizens' School Advisory Council.

The line and staff organization is being achieved as it was originally recommended. A re-examination of the role of the special service division to both the instructional and administrative personnel appears to be desirable.

One of the most significant areas of development in the instructional program has been in the quantity and quality of the guidance program.

Some plans of the projected buildings, sites, and service areas did not develop. This was due to changing growth patterns.

The plan of combined use of school facilities by school and community has been achieved. A total of 243 separate groups and agencies used the buildings during the 1957-58 school year.

The discrepancy between the estimated and actual financial projections have not hindered the over-all long-range financial plan. The financial projections were a valuable guide for determining the best method of meeting the needs of the district.

The results of this study indicate that the long-range plan presented in The Bellevue Story served as a valuable guide for school development during a period of rapid growth. In general, most of the recommendations have been achieved, and those recommendations not achieved were re-evaluated in light of changing conditions in the district. Microfilm $3.50; Xerox $11.80. 270 pages.

1. Bellevue Citizens' School Advisory Council, The Bellevue Story: A Community Plans for Its Schools (Bellevue, Washington: Bellevue Citizens, Bellevue School District, and King County Planning Commission, 1951).

AN INVESTIGATION OF TECHNIQUES FOR PREDICTING SCHOOL DISTRICT ENROLLMENTS IN FLORIDA

(L. C. Card No. Mic 59-6105)

Donald Lee Peterson, Ed.D.
The University of Florida, 1959

Statement of the Problem

The problem of this dissertation was to examine various techniques for predicting school enrollments and to determine which techniques are most satisfactory and practical for predicting future school enrollments in Florida.

Plan of This Study

A. Determination of the most reliable technique.
   1. Project enrollment by selected projection techniques for each county and for each race separately.
   2. Compare the results of the various techniques to determine which technique is most reliable.
   3. Group the counties by direction and by degree of accuracy of projection.
   4. Compare the results of the various projections for the groups of counties which were the most inaccurate to determine if one of the selected techniques of projecting school enrollments, other than the one deemed most reliable, would be more appropriate for these groups.

B. Investigation of selected factors which may affect accurate projections.
   1. Investigate selected community factors found in published material which may indicate future enrollment trends.

2. Investigate possible relationships existing between the selected community factors and the counties selected on the basis of accuracy of projections.
3. Investigate selected factors which do not appear in published material which may indicate future enrollment trends.

Conclusions

1. Of the techniques tested, the survival-ratio techniques utilizing projection ratios for predicting school enrollments are generally more reliable than other techniques used.
2. No data in published form appears to be available which could be effectively used to predict the effects of special community factors on the reliability of the survival-ratio technique for projecting school enrollments as used in this study.
3. The survival-ratio technique of predicting school enrollments, as used in this study, does not seem to predict school enrollments accurately when a change in the rate of increase or decrease of school enrollments occurs. This conclusion was indicated by the analysis of arbitrary enrollment models set up to study selected variables and the analysis of the rate of change of average daily membership for the period of time for which the projections were made. When the rate of change is accelerating or decelerating, some adjustments must be made in the techniques to compensate for such changes.
4. Data which could be used as a basis for making reliable compensatory changes in the projection ratios are not obtainable from school enrollment statistics.
5. At the present time, adequate attention is not being given to the analysis of impending events which might affect changes in school enrollment trends in a community. Required modifications in projection ratios are not being made to compensate fully for the effect of impending events on the survival ratios. These conditions, which have not yet had much effect on enrollments, are potential causes of change and are, possibly, the greatest source of error in making accurate enrollment forecasts. Information regarding impending events will not usually be found in printed form; any data which might be useful to educators who are responsible for the forecasting of pupil enrollments must be obtained from those persons closely associated with the impending event.

Microfilm $2.70; Xerox $9.40. 208 pages.

SOME VARIABLES AMONG ELEMENTARY SCHOOL TEACHERS THAT AFFECT THE UTILIZATION OF AUDIO-VISUAL MATERIALS

(L. C. Card No. Mic 59-5328)

Theodore Schor, Ed.D.
Rutgers University, 1959

This study sought to ascertain if any determinable relationships existed between the teacher use of audio-visual materials and (1) teachers' professional attitudes, (2) teachers' personality characteristics, and (3) teachers' attitudes toward audio-visual materials used for instructional purposes.

Procedures involved in this study included: (1) a survey of the related literature and research, (2) the selection of the Minnesota Teacher Attitude Inventory and the Thurstone Temperament Schedule to measure certain teacher attitudes and temperament traits, (3) the construction of the Teacher Audio-Visual Attitude Inventory to measure certain attitudes of teachers toward audio-visual materials, (4) the administration of the three instruments to two criterion groups of teachers, those who made the greater use of A-V materials and those who did not use such materials to any great extent, (5) the tabulation and statistical treatment of the data, and (6) the drawing of conclusions and implications.

The subjects of the study were two groups, each of thirty public elementary school teachers, taken from a total of 112 teachers in seven schools in three school districts in the central part of Middlesex County in the State of New Jersey. One group, showing the greater use of audio-visual materials, comprised the upper 27 per cent of the total number of teachers. The other group included those who made little use of such materials and constituted the lower 27 per cent of the total.

The reliability of the Teacher Audio-Visual Attitude Inventory, especially constructed for this study, was determined by employing the "split-half" method with correction by the Spearman-Brown formula, and used with a group of 334 elementary teachers selected from school districts which were members of the Middlesex County Educational Audio-Visual Aids Commission but not included in the main study. The reliability coefficient was found to be .60. Adding the Study Group of 112 teachers to the aforementioned group of 334 gave a total of 446 elementary teachers with a resulting "r" of .58. The phi coefficient was used to calculate the item-test correlations in order to determine the discriminatory power of the items of the constructed Inventory.

FINDINGS

Teachers who made the most use of audio-visual materials had:

1. significantly higher mean total scores on the Minnesota Teacher Attitude Inventory.
2. significantly higher mean total scores on the Thurstone Temperament Schedule. The individual temperament trait areas showing the greatest differentiation between the criterion groups were the Dominant, the Sociable, the Vigorous and the Reflective.

3. significantly higher mean total scores on the Teacher Audio-Visual Attitude Inventory.

4. greater agreement with research findings on many more items of the Teacher Audio-Visual Attitude Inventory.

5. response patterns on the Teacher Audio-Visual Attitude Inventory that indicated greater understanding of the value of in-service programs, of the need for the availability of equipment, materials, and space, and of the place of these materials in the teaching-learning situation.

6. reported many more favorable incidents relating to their use of such materials.

7. moderate positive correlations (.25 to .43) between their scores on the Teacher Audio-Visual Attitude Inventory and scores on the Thurstone Temperament Schedule. The other criterion group showed small negative or no correlations.

8. moderate positive correlations (.29 and .33) between their scores on the Teacher Audio-Visual Attitude Inventory and scores on the Minnesota Teacher Attitude Inventory. No correlations were found for scores of the other group.

CONCLUSIONS AND IMPLICATIONS

Teachers who make the greater use of audio-visual materials:

1. also are likely to be more successful, as measured by the Minnesota Teacher Attitude Inventory, in establishing and maintaining harmonious classroom relationships with their pupils.

2. appear to have a more pronounced degree of certain temperament traits which, according to previously reported research with the Thurstone Temperament Schedule seem to have a relationship to desirable teacher effectiveness in certain classroom situations.

3. tend to appreciate more fully their own professional roles in the teaching-learning situation and the importance of the role of instructional materials in the learning process.

Microfilm $2.50; Xerox $6.60. 136 pages.

A STUDY OF STATE HIGH SCHOOL GRADUATION REQUIREMENTS IN MISSOURI

(L. C. Card No. Mic 59-5629)

Robert Calvin Shaw, Ed.D.
University of Missouri, 1959

Supervisor: John Rufi

PURPOSE: The primary purpose of this study was to survey the opinions of principals of selected Missouri secondary schools concerning the need for revision of the state high school graduation requirements presently in effect.

METHOD OF RESEARCH: Data for this study were secured primarily from information forms sent to the principals of 287 selected Missouri secondary schools and from examination of the cumulative records of certain graduates in eighteen selected Missouri secondary schools.

SUMMARY: 1. State high school graduation requirements in the United States developed from college admission standards originally established in the United States at Harvard College in 1642.

2. The legal right to set state high school graduation standards was granted to the Missouri State Superintendent of Public Schools in 1903, but a set of requirements was not established until 1916.

3. Missouri is one of the two states which require as many as eleven units of definitely-specified course work for high school graduation. No state requires more than this number.

4. The policy of issuing more than one kind of diploma signifying high school graduation was found to be practiced by fewer than one per cent of the Missouri public schools included in this study.

5. The policy of issuing certificates of some kind in lieu of diplomas to those pupils who are mentally incapable of completing state high school graduation requirements was found to be the policy of 10.0 per cent of the schools included in the study; however, 71.7 per cent of the principals of these schools indicated their personal approval of such a policy.

6. It was the opinion of a majority of the principals included in this study that the state high school graduation requirements presently in effect are the most appropriate requirements which should be specified by the state.

7. An examination of the four-year high school records of 601 graduates (1958) in eighteen selected high schools who ranked in the upper 15 per cent of their class scholastically showed that 67 per cent has completed four or more units of English, 78 per cent had completed two or more units of mathematics, 66 per cent had completed two or more units of natural science, 52 per cent had completed two or more units of foreign language, and 63 per cent had completed nineteen or more total units.

CONCLUSIONS: 1. A comparison of the high school graduation requirements specified by the forty-nine states appears to show that the standards specified by the Missouri State Department of Education are among the most exacting requirements in the United States.

2. An analysis of the opinions of principals in selected Missouri secondary schools appears to show that, in the judgment of these principals, the educational needs

of their pupils can be effectively met within the present framework of requirements and that there is therefore no need to revise the state high school graduation requirements presently in effect in Missouri.

3. The amount of variation permitted in each pupil's pattern of course work by Missouri's state high school graduation requirements, combined with the fact that many of the pupils of high scholastic achievement far exceed the state's minimum requirements, adds to the responsibility and opportunity for effective counseling in this area.

4. The Missouri State Department of Education should consider the adoption of a set of recommendations relating to the issuance of certificates of some kind to pupils who are mentally incapable of completing state high school graduation requirements.

Microfilm $4.50; Xerox $15.20. 352 pages.

OPINIONS CONCERNING THE EFFECTIVENESS OF PRACTICES IN SCHOOL-COMMUNITY RELATIONS

(L. C. Card No. Mic 59-5499)

Jody LaWayne Stevens, Ed.D.
The University of Oklahoma, 1959

Major Professor: Claude Kelley

The period since World War II has seen great progress toward renewed public interest and participation in education. This interest has been stimulated by the pressing problems confronting the schools and the increased acknowledgement by our educational leaders that the support for public education depends on the goodwill of the people. Laymen want to know about all phases of the school program. Herein lies the problem of today; people know little about their schools and much of what they do know is often distorted and incomplete. A great variety of school-community relations practices are currently employed by superintendents in an attempt to keep their citizenry informed about the school program and its activities.

The problem for this study was: How do the opinions of laymen and superintendents agree as to the effectiveness of school-community relations practices and what are the implications of their agreement for the administration of a public relations program? This study was concerned with the obligation of the school and its educational leader to interpret the school program and to keep the people informed about school activities and functions. It was further concerned with the kinds of media used and the effectiveness of these media as reported by the opinions of laymen and superintendents.

One hundred thirteen superintendents of member school systems of the Oklahoma Commission on Educational Administration and 339 laymen from these cooperating school districts participated in the study. These participating school systems were representative of various sized schools and represented 58 of the 77 counties in the state of Oklahoma.

Findings:

1. Public school patrons are interested in all phases of the school program. They want to know more about the school and want the information to be the most direct and reliable.

2. A wide variety of media should be utilized by superintendents in an attempt to keep the public informed.

3. Superintendents are not fully aware of public relations media felt to be most effective by laymen.

4. Superintendents should rely on and make full use of practices most often listed as effective by laymen.

5. The effectiveness of some public relations practices vary between size of schools.

6. Certain public relations practices have been identified as most effective and least effective by laymen and superintendents.

Recommendations:

1. School administrators should rely on those practices identified by laymen as most effective and place less emphasis on other public relations media.

2. The school administrator should insure that public relations programs include those items identified as most effective.

3. Further investigation to determine the kind and amount of school information desired by laymen should be attempted.

4. A study should be made to identify the sources by which laymen receive the most information concerning the school.

Microfilm $2.50; Xerox $8.00. 174 pages.

INTER-RELATIONSHIPS WITHIN THE COMPETENCY PATTERN FOR SCHOOL ADMINISTRATORS

(L. C. Card No. Mic 59-5659)

Robert Floyd Todd, Ph.D.
University of Mississippi, 1959

Chairman: Dr. Richard E. Keye

Purpose of the Study

The purpose of this study was to determine possible inter-relationships of the 814 administrative behavior requirements as established in three previous studies made at the University of Mississippi.

In addition to the main purpose of establishing an inter-relationship, the writer proposed further to formulate a guide to effective educational administration from these 814 behavior requirements.

Procedure Used in the Study

A keysort card was used for each of the 814 behavior requirements, and an entry was made on each card which indicated the task area and category in which the behavior appeared as well as the number of times it was cited as being effective or ineffective. The 814 cards were numbered consecutively.

Each of the behavior requirements was then compared with the other 813 behavior requirements to determine a possible relationship between it and the other behavior requirements. A listing and coding system was employed to indicate:

1. The frequency of each behavior requirement common to more than one task area.

2. The behavior requirements within each task area which were related.

3. The behavior requirements which were related among the eight task areas.

Conclusions

Based on an analysis of the data, the writer drew the following conclusions:

1. Of the 814 behavior requirements examined, only 328 were found to be inter-related.

2. From the 328 behavior requirements which were found to be inter-related, 120 inter-relationships can be established.

3. The 120 inter-related behavior requirements should be important to the school administrator because they can be used as a guide to partial fulfillment of the tasks of school administration. Competence in the 120 inter-related behavior requirements represents competence in 328 behavior requirements scattered throughout the total of 814 behavior requirements.

4. Of the 328 behavior requirements which were found to be inter-related, Task Area VII, Organization and Structure, contains the greatest number which were inter-related; namely sixty-one. Fifty-five of this number were related to behavior requirements outside the task area of Organization and Structure. This figure represents the greatest number of behavior requirements found in any task area which were externally related. Therefore, the writer concludes that a public school administrator who demonstrates competence in the task area of Organization and Structure will more likely be competent in the other seven task areas than one who demonstrates competence in any other one task area.

5. Although Task Area VI, School Transportation, contains more behavior requirements, namely 145, than any other task area, only fourteen were found to be inter-related. This was the smallest number from any task area found to be inter-related. Therefore, the writer concluded that competence in the task area of School Transportation probably has less carry-over to other task areas than does competence in any other of the seven task areas.

6. The job of the public school administrator is a complex one; this is evidenced by the fact that 814 behavior requirements were identified in the eight task areas of school administration. Because of this complexity, the preparation program of educational administration is complex.

7. Competency in any one task area does not insure competency in the other seven task areas since only 328 of the 814 behavior requirements were found to be inter-related. No behavior requirements was found to be related in all eight task areas; in fact, only two behavior requirements were found to be related in as many as five task areas.

8. The results of this study show that a public school administrator must be competent in specific tasks that are unique to a specific task area as evidenced by the small degree of inter-relation found among the 814 behavior requirements. Thus, an administrator relying upon general "common sense" principles to insure competency in the eight task areas probably will have less chance for success that the administrator who is well grounded in the basic principles of school administration involved in all areas.

Microfilm $2.50; Xerox $7.80. 169 pages.

EDUCATION, ADULT

A SURVEY TO DETERMINE THE POST-SECONDARY NEEDS OF YOUTH AND ADULTS IN SUMMIT COUNTY AND PROPOSALS FOR MEETING THESE NEEDS

(L. C. Card No. Mic 59-6624)

Robert Simeon Brown, Ph.D.
The Ohio State University, 1954

Summit County is located in the northeastern part of Ohio. It is bounded on the north by Cuyahoga County, on the east by Portage and Stark counties, on the south by Stark County, and on the west by Wayne and Medina counties. The total area of Summit County is 419.38 square miles. This is a highly industrial area with an excellent network of roads indicating modern transportation facilities. The population of Summit County in 1950 was 410,032.

The fundamental purpose of the dissertation is the formulation of a series of recommendations for a community-college program in this section of Ohio. To accomplish this purpose, an effort was made —

1. To determine from the Summit County high school seniors, their parents, and school administrators their need for further educational opportunities.

2. To establish a set of criteria for a post-secondary extension of educational opportunity for Summit County, Ohio.

3. To formulate a community-college law for the state of Ohio embodying the fundamental criteria of such a program adaptable to this region.

As a means of discovering the further educational needs of youth and adults in this area, questionnaires were distributed to the 3,067 high school seniors enrolled in the public schools in November of the 1953-1954 school year, to the parents of these seniors as well as to the twenty-nine high school principals and executive heads of the Summit County school districts. In all, 6,163 questionnaires were distributed and 49.4 per cent were returned. Responses were received from 2,029 seniors, 992 parents, and twenty-nine school administrators.

Chapter I of the dissertation provides an overview of the study. This includes an introduction, statement of the problem, limitations of the study, definition of terms, related studies, sources of data and methods used, as well as the response to the questionnaires and the general plan of the study. Chapter II relates topography, size, transportation facilities, industry, population, valuation and the present educational facilities found in Summit County to the location of possible community colleges. Chapter III shows the opinions of the seniors in reference to their future plans; the need for additional educational opportunities; and the most desirable curriculum for such an institution. Chapter IV reveals the opinions of the parents of the seniors in reference to their plans for their children, their interest in a proposed community-college program, and their desire for the most suitable curriculum to meet these needs. Chapter V shows the opinions of the school administrators regarding the desirability and need for the public community college in the Summit County area. After a thorough study of the available material on the needs of community and principles for colleges, the writer has, in Chapter VI, presented a set of community-college criteria specifically applicable to this area. Also in this chapter are found judgments on the legal aspects of community-college legislation as well as a proposed community-college law for the state of Ohio. Chapter VII presents the summary of the findings of the study and recommendations for a county-wide community-college of the study and recommendations for a county-wide community-college program.

The Opinions of the Seniors — The responses of the 2,029 seniors who returned questionnaires indicated that 821 (40.5 per cent) planned to attend a four-year college, 494 (24.3 per cent) did not plan to attend a four-year college, and 714 (35.2 per cent) were uncertain about their future plans.

Greater interest was shown by the seniors who did not plan to attend a four-year college in a free local community college than in such an institution charging tuition. A total of 37.2 per cent of this group favored the free program; 22.9 per cent showed an interest in attending such a college if it charged $75.00 tuition a semester.

The seniors who did not plan to attend a four-year college revealed a total of 2,848 occupational choices to study in a proposed community college. The requested fields of study included subjects in the areas of business, trades, and professions.

Great interest was shown among all seniors in general education courses in a community-college curriculum. Five hundred and eighty-two seniors who planned to attend a four-year college requested general education courses, and 1,087 seniors not planning to attend a four-year college made requests in the same field.

Three-hundred and thirty college-bound seniors indicated an interest in forums, lectures, and lyceum courses; while 486 seniors who did not plan to attend a four-year college indicated similar interests.

The Opinions of the Parents of the Seniors — More than 59.8 per cent of the joint responses of the parents indicated a desire to send their children to college. A total of 300 parents who did not plan for their children to attend a four-year college desired some additional school work for them.

The parents whose children were going to work directly upon leaving school stated that the fields of business, semi-skilled work, trades, public service, and agriculture were the most attractive for life occupations.

The parents' separate interests in a local tuition-free community college showed that 212 fathers and 270 mothers were interested in a local tuition-free terminal program. The parents were more interested in a local community college than in the community college at Akron University.

All together, 3,472 requests were made by the parents and their children for a community-college curriculum involving courses of a pre-professional nature. These courses were given several groupings: trades, business, professions, public service, agriculture, technology, and miscellaneous.

The joint responses of the parents revealed 715 choices in the area of general education and 376 requests for weekly, semi-monthly, or monthly forums; lectures; or lyceum courses.

The Opinions of School Administrators — The school administrators estimated that 1,043 seniors(34.0 per cent) would attend college and that 1,314 of the Summit County seniors (42.8 per cent) had the ability to complete college work.

In response to the question, "Do you feel that the seniors might be interested in a two-year community college?" twenty-five school administrators replied in the affirmative; three gave a negative reply; and one administrator was doubtful.

Twenty-two of the administrators indicated that, in their opinion, the terminal program was the most desirable for a community-college, while one felt that the college preparatory course met a greater need.

Two years of college credit seemed advisable for the proposed community college, either in the local district or at Akron University. Sixteen of the administrators felt that such a course should be recommended, while 11 were undecided. Two of this group did not feel that the first two years of college credit, if available, would increase the over-all value of this type of offering.

The reader should note that eleven of the administrators felt that our high schools sufficiently train our youth to live in the modern world; however, fourteen of this group did not feel that the present secondary program provides the necessary training. The writer wants to indicate that this is a very significant point in the study.

Only five, or 20.8 per cent, of the twenty-four high schools represented in the survey, offer adult education courses. The entire city of Akron is served by South High School, while the high schools located in Barberton and Cuyahoga Falls serve their respective localities. Two county districts, Copley and Twinsburg, are making an effort to serve their respective communities.

Twenty-five administrators felt that the adults in Summit County would be interested in a community-college terminal program. The lack of sufficient opportunities in the area of adult education now apparent in our high schools of this area and the expressed interest support the judgment of the administrator.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

According to the estimates of this group of educators, 52.6 per cent of the seniors could do acceptable work in a community-college preparatory course and 74.5 per cent could do acceptable work in a community-college terminal program.

The need of a full-time community-college program in this area is further substantiated by the administrators' answers to the question, "Do you feel Summit County would profit by a sound full-time community-college program?" Twenty-two replied "yes," two answered "no," and three did not answer. One administrator replied "perhaps," while two questioned the desirability of competing with Akron University and Kent State University.

According to the results of the questionnaires from the administrators, the drop-out rate would not be greatly affected by the institution of a community-college program in this area. Eleven did not feel the community-college program would affect drop-outs, while 9 felt that the community-college program would help the cause of drop-outs. Five were "undecided" about this question and four stated that such a course would have "little effect" on drop-outs.

There is an apparent need for broad course offerings in the areas of general education and for weekly, semi-monthly or monthly forums. The curriculum of a community college in this area would be very broad if all the needs of both youth and adults were met.

RECOMMENDATIONS

On the basis of the tabulated data and in view of the criteria developed for a community-college program in Summit County, Ohio, the following recommendations are presented:

Legislation - Public Community College Law

a. Effort should be made to gain approval of legislation by the General Assembly of Ohio which would permit a school district or districts, meeting the criteria set by the State Department of Education, to establish a local community college.

1. The community college should remain a two-year institution. The law should make this provision mandatory.

2. A majority of the voters in this district should approve the establishment of the community college. Final approval rest in the hands of the State Department of Education.

3. All facilities and equipment afforded public school pupils should be available to the thirteenth and fourteenth grades.

4. School personnel in all levels of employment in the community college should enjoy the same privileges of salary schedules, tenure, retirement, membership in professional organizations and retirement as do the present public school employees of the state.

5. The minimum assessed valuation of the proposed community-college district should be $20 million.

6. The minimum enrollment of high school pupils in the proposed community-college should be 700 pupils.

7. The minimum enrollment of full-time pupils in the proposed community-college should be 200 students.

8. The community-college opportunities should be offered tuition-free to all interested youth and adults in the district.

Legislation - A County-wide Taxation Plan for Akron University

B. The provisions of House Bill 721 should be placed on the ballot, which, upon approval of the electorate, would provide county-wide tax support to the Municipal University of Akron.

1. The community-college program at Akron University should be available to all youth and adults in Summit County on a tuition-free basis.

2. The curriculum of this institution should be broadened to include courses most desired by the youth and adults.

3. Provisions should be made to permit the enrollment of youth and adults of adjoining counties to attend the Akron University Community College upon payment of a minimum tuition fee.

Steps of Development

Step I - Channel of Development

The State Board of Education should conduct a statewide survey to develop, by means of whatever procedures it deems necessary, a comprehensive plan providing for tentative general locations and orderly, efficient establishment, according to need, of community colleges throughout the state. This study should be made under the direction of the State Board of Education and the State Director, financed by the General Assembly of Ohio. During this period of community-college development all due consideration should be given to the present four-year colleges and universities in the state.

4. All services of all available state consultants and those acquainted with the characteristics of the community-college program should be solicited.

Step III - Organization

1. The community college should provide —

a. Terminal education for students interested in preparing for various technical and semi-professional occupations requiring training beyond the twelfth grade.

b. Terminal education for students who plan to improve their general education before entering the fields of employment or homemaking.

c. Opportunity for adults and other youth to continue their education on free time.

d. Opportunity for students to prepare for admission to professional schools and the last two years of technical and liberal arts colleges.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

2. The community college should be, in reality, the thirteenth and fourteenth years of the public school and be closely integrated with the same. The plan of organization should be flexible enough to meet the changing needs of industry, business, and employment.

3. Day and evening classes should be available. Existing extension divisions of the colleges and universities should be utilized.

4. An adequate physical plant, including library services, should be available.

5. An adequate teaching, clerical, and custodial staff should be provided.

6. The criteria for community-college standards, as prescribed by the State Department of Education, must be evaluated constantly at the local community-college level.

7. All available community agencies should have direct contact with the community-college personnel to assist in job placement and employment.

Step IV - Administrators and Supervision

1. The administration of the local community college should be the direct responsibility of the local Superintendent of Public Schools and the local Board of Education.

2. The State Department of Education should, through its evolving standards for the community-college, constantly evaluate these programs and provide any assistance requested beyond the local level of administration and supervision.

Step V - Finance

1. The community college should be supported to the greatest possible extent by local monies, supplemented by state funds through a revised school foundation program law. It may be necessary to charge a minimum tuition fee in the beginning, but at the earliest possible date, this practice should be discarded.

2. Wealthy districts should be encouraged to support their local institution independently.

The general trend of the community-college movement and the need thereof is well summarized by President Norman P. Auburn, who, when addressing the Board of Directors at Akron University on June 10, 1954, stated, "It is not too soon to consider enrollment problems which will confront our colleges and universities by 1960. Those who will attend college in the next decade are now crowding the elementary schools. Possible approaches to handling this increase are gearing up schools to handle more students, starting more junior colleges establishing 13th and 14th grades in the public schools, and more complete training by technological schools."

Locations of Proposed Community Colleges

The following districts, upon meeting the criteria and upon the approval of the State Department of Education, are proposed as possible sites of the new community college:

District 1. The City of Akron. The community college would be located in one or more of the eight high schools. The estimated enrollment would be 500 full-time students.

District 2. The City of Barberton. The community college would be located in the Barberton High School. The estimated enrollment would be 220 full-time students.

District 3. The City of Cuyahoga Falls. The community college would be located in the Cuyahoga Falls High School. The estimated enrollment would be 370 full-time students.

District 4. The townships of Bath-Richfield, Boston, Hudson, Northfield-Macedonia, Twinsburg and Northampton. The community college would be located at Hudson High School. The estimated enrollment would be 200 full-time students.

District 5. The townships of Stow, the village of Mogadore, the village of Silver Lake and the city of Tallmadge. The community college would be located in the Tallmadge High School. The estimated enrollment would be 175 full-time students.

District 6. Green and Springfield townships. The community college would be located in the Springfield High School. The estimated enrollment would be 215 full-time students.

District 7. Coventry and Franklin townships. The community college would be located in the Coventry High School. The estimated enrollment would be 155 full-time students.

District 8. Copley and Norton townships. The community college would be located in the Norton High School. The estimated enrollment would be 200 full-time students.

Microfilm $3.40; Xerox $11.60. 263 pages.

Abstract published by special arrangement with The Ohio State University.

EDUCATION, HISTORY

A HISTORICAL STUDY OF TEACHERS' ASSOCIATIONS IN NORTH CAROLINA, 1830-1883

(L. C. Card No. Mic 59-5562)

William Gordon Kornegay, Ph.D.
The University of North Carolina, 1959

Supervisor: Samuel M. Holton

The purpose of this study was to trace the history of the antecedents to the present teachers' associations in North Carolina and to show how they were founded, who belonged to them, what their members concerned themselves with, and when possible, what was their influence.

The earliest organization studied was the North Carolina Institute of Education which held meetings in Chapel Hill from 1831 until 1834 and included in its membership influential teachers and friends of education in the state. The next group studied was the Guilford Association of the Friends of Education (1849-1850) which appears to have been the first county teachers' group in the state. Attempts in 1852 by teachers in Raleigh to form a state association are noted as are the activities of the successful State Educational Association (1856-1864) which existed under the leadership of Calvin H. Wiley. This latter association was also responsible for the formation of a Confederate Educational Association (1863-1864) which held two meetings.

In the post-war period, an account is given of the attempts of a county association in Chatham County to rebuild a state association in 1869. There was a state association which existed from 1873 to 1875 as well as one founded in connection with the University Normal School (1878-1883). County, district, and religious teachers' associations in the post-war period were also important.

As to how the various associations were founded, there are several findings. The state's newspapers strongly supported the associations and often took the lead in pressing for their formation. Calvin H. Wiley, the first State Superintendent of Common Schools, was certainly the leading light in the 1856-1864 Association. In the reconstruction period, the prime movers behind the 1873-1875 group was the State Board of Education.

As to the composition of the membership, none of the associations were ever truly representative of the profession. The common school teachers were slow to take part in the associations. The bulk of the membership usually was drawn from the more prominent teachers and friends of education in the state. College professors and private school teachers usually were the organizations' leaders.

The areas with which the members concerned themselves are broad. Lively and persistent interest was shown in the extension of popular education, the improvement of teachers, teacher welfare, methodology, materials and administration.

A final aspect of the study was to determine, when possible, the influence of the associations. Their influence seemed to manifest itself most strongly in three areas: (1) the "professionalization" of teachers, (2) the bringing of pressure to bear on the legislature, and (3) the publicizing of the cause of education and the profession in general.

Microfilm $2.65; Xerox $9.20. 201 pages.

THE HISTORY AND DEVELOPMENT OF PUBLIC SCHOOL PUPIL TRANSPORTATION IN MISSISSIPPI

(L. C. Card No. Mic 59-5658)

William Elbert Middleton, Ed.D.
University of Mississippi, 1959

Chairman: Dr. S. A. Moorhead

Purpose

The purpose of this study was to trace the development of public school transportation at public expense in Mississippi from its inception to and including the school year of 1957-58. The study does not include private schools or institutions of higher learning but limits itself to public tax supported schools of elementary and secondary level.

Procedure

A correspondence was carried on with the State Department of Education of Mississippi and state education officials were interviewed. In addition, general educational histories of school transportation and related studies, Mississippi State Department of Education bulletins, reports and pamphlets, general laws of Mississippi, Mississippi Supreme Court Cases and Attorney Generals' Opinions were reviewed. The available material was then collected and analyzed.

The study, in general, follows a chronological sequence with the body of the dissertation organized under the following headings: (1) The Beginning of Pupil Transportation in Mississippi, (2) The Era of Private Ownership and Operation, (3) Counties are Authorized to Purchase and Operate School Buses, (4) The State Minimum Foundation Program and Transportation, and (5) The Status of School Transportation in 1958. These headings are then broken down into the following phases: (1) Administration and Finance, (2) Personnel and Equipment, (3) Legal Decisions and Opinions, and (4) Developmental Status.

Summary

The first state law providing for transportation of children to school at public expense in Mississippi was passed in 1910. This measure provided for the transporting of children when schools were consolidated.

The 1910 law left the administration of school transportation to local and county school officials with no mention being made of the exercise of authority from the state level.

In 1935 a major change was made in the administration of school transportation. Previous to 1935 full jurisdiction over the awarding of transportation contracts was vested in the local school board and the county superintendent of education, but in that year this authority was given to the county school board.

The first state school transportation officials were appointed in Mississippi in 1946, when the State Department of Education was reorganized. These officials were a Supervisor of Transportation and a Director of Transportation.

Initially the financing of school transportation was a local matter; however, in 1924 an equalizing fund was

established to aid the poorer counties of Mississippi in their educational endeavors, and consequently, allotments were made from the state for transportation purposes. In 1953 the legislature enacted a minimum foundation program for education and provided for the financing of school transportation from the state level.

The first vehicles used for school transportation in Mississippi were wagons but by 1920 motor vehicles had begun to be used. The contracting for school transportation was left much to the discretion of the local school boards until 1924, when the laws required that the contractor be the lowest responsible bidder.

Prior to 1944 nearly all school transportation was privately contracted with the children being transported to school in wooden bodied vehicles. In 1944 the legislature passed a law authorizing counties to purchase and operate school transportation equipment and in 1953 passed additional laws which required all school buses to be of all-steel construction.

Few Negroes were transported to school in Mississippi prior to World War II; subsequently, there was a noticeable increase in the number of Negro children transported. This effort was accelerated through special legislation which was enacted in 1953 so that by 1958 the percentage of Negro and white children transported to school was almost equal.

In 1943 only 30.8 per cent of the school children in Mississippi were being transported to school; by 1958 the number transported was 248,500, representing 55.95 per cent of the school children.

Microfilm $3.45; Xerox $11.80. 268 pages.

A HISTORY OF THE STATE DEPARTMENT OF PUBLIC INSTRUCTION IN NORTH CAROLINA, 1852-1956

(L. C. Card No. Mic 59-5574)

David Hyde Prince, Ph.D.
The University of North Carolina, 1959

Supervisor: Arnold K. King

This study traces the development of the North Carolina State Department of Public Instruction from 1852, when the office of General Superintendent of Common Schools was created, to 1956. It is based on original records that have been deposited in the Department of Archives and History, other original records in the Department of Public Instruction, letters of educational and political leaders, State publications newspapers, and educational journals.

The Department of Public Instruction was not actually established until 1868, but earlier some of the functions of the Department were carried out by the first Superintendent, Calvin H. Wiley. Gradually other functions became the responsibility of the Department, and occasionally functions were dropped or were transferred to other state agencies.

The office of Superintendent of Public Instruction was provided in the State constitution of 1868, and the Department of Public Instruction was organized by the first Superintendent elected by the people, S. S. Ashley. The Department carried out the duties assigned to it by the State Board of Education and those required by the school law of 1869.

The progress made toward establishing the Department was wiped out in 1870 in the political reaction against the Reconstruction government of the State. The General Assembly abolished the four staff positions of the Department and reduced the Superintendency to little more than a clerkship. From 1870 to 1902 there was no functioning Department of Public Instruction. The State Superintendent worked alone until 1881 when he was granted funds with which to employ a clerk.

Under the leadership of Superintendent James Y. Joyner from 1902 to 1918 the Department began to develop into a strong state educational agency. In 1902 there were only two members of the Department. Gradually other staff members were employed to perform the increasing number of functions assigned to the Department by acts of the General Assembly, by orders of the State Board of Education, and by the rules laid down by philanthropic agencies as prerequisites for giving educational funds to the State.

The divisional organization of the Department began in 1920. By 1924 there were fifty-three staff members in ten divisions, and by 1930 there were twelve divisions. After the office of Controller to the State Board of Education was created in 1943, some of the functions of the Department were transferred to that office. By 1946 the number of Divisions had been reduced to six. The functions of the Department were greatly expanded in the next decade, and four new divisions had been added by 1956.

From 1853 to 1866 the annual expenditure by the State for the administration of public education was $1,500, the amount of the State Superintendent's salary. In 1868 the annual budget of the Department of Public Instruction was $7,150. This was reduced to $1,500 in 1870 and so it remained until 1881 when it was increased to $2,600. Twenty years later it was only $2,850. By 1920 the annual budget had increased to $39,940, and in 1955-1956 it was over $420,000.

In a period of a little more than 100 years the Department of Public Instruction has developed from the few functions carried out by the Superintendent alone into the principal agency of the State for the administration of public education with a staff of 230 persons. Under his direction it is responsible for performing the duties and functions delegated to it by the General Assembly and the State Board of Education.

Microfilm $6.25; Xerox $21.80. 491 pages.

F. M. DOSTOEVSKY: HIS IMAGE OF MAN. DOSTOEVSKY'S VIEWS ON EDUCATION AND HIS PHILOSOPHY

(L. C. Card No. Mic 59-4656)

Miriam Taylor Šajković, Ph.D.
University of Pennsylvania, 1959

Supervisor: James A. Mulhern

The present work is an initial attempt to introduce American educators to the thought of Fyodor M. Dostoevsky in the field of educational philosophy. The views of

Dostoevsky on contemporary educational problems of his own time have been historically explored, and the central aspects of his philosophy have been studied in order to see what his contribution might be toward the formulation of a philosophy of education for today.

The procedure involved in the study has entailed the historical and descriptive methods in the selecting, collating, and organizing of materials. The analytical method was employed in relation to the study of Dostoevsky's educational views and his philosophy.

Chapter I presents a short historical background of the ideological developments in nineteenth century Russia in order to lend perspective in understanding the place and significance of Dostoevsky. Particular attention is drawn to the official Tsarist regimes, the movements of the Westernizers and the Slavophils, and outstanding thinkers: N. I. Pirogov, L. Tolstoy, K. D. Ushinskii, and F. M. Dostoevsky, who remain apart from the specific movements.

Chapter II is the biography of Fyodor M. Dostoevsky. The intention has been to transmit the living spirit and thought of Dostoevsky mainly by materials found in his letters, notes and works, and from the reminiscences of his family and his intimate friends.

Chapter III is a study of Dostoevsky's analyses and criticism of specific educational problems, found in his letters, in articles from The Diary of a Writer, and in several artistic works. Here are located Dostoevsky's views on the aim of education, his ideas about public education, religious education, women's higher education, the problem of general education and specialization, the importance of language, the significance and value of reading, and the foundation of education for citizenship.

Chapter IV gives Dostoevsky's views on character education. Particular attention has been given to the following topics: the impact of society upon the character of youth, the re-education of "insulted and injured" youth, the ideals of youth, psychological observations on childhood and youth natures, and the role of the fimily in the formation of character.

Chapter V presents a brief survey of Dostoevsky criticism and Dostoevsky's method of criticism and his methodology. The central aspects of his philosophy are formulated: the religious theme, the ethical theme, the origin, meaning, and significance of ideas, the role of reason, man and freedom, evil and suffering, and life and love.

Chapter VI summarizes the main points of the work. A short resume of the prevailing view of naturalistic philosophy is developed in order to show the contrast between it and Dostoevsky's theistic philosophic position.

The result of this study opens up the reconsideration of religion, metaphysics, and the problem of the origin of ethical values. This leads to the reinstatement of a serious study of religion, metaphysics, and ethics over the now dominant interest in pedagogical methodology, and would redirect thinking and reflection in the formulation of a philosophy of education.

Microfilm $2.90; Xerox $10.00. 222 pages.

EDUCATION, PHYSICAL

CONTRIBUTIONS OF PHYSICAL EDUCATION TO SELECTED PROBLEM AREAS PROPOSED FOR A CORE PROGRAM IN THE SECONDARY SCHOOL

(L. C. Card No. Mic 59-5399)

Mary Elizabeth McCoy, Ph.D.
The Ohio State University, 1953

> . . . progress lies not in substitution of new names for old habits but in the transformation of old habits into a new quality of mind and heart.[1]

For the past half-century, eminent educators have devoted thought, time, and research to evolve improved systems for the reorganization of the secondary schools throughout the nation. Many considerations led to these efforts, the chief ones perhaps being (1) that there is a great difference in character between the high school populations of today and those of 1900; (2) that educational research reveals very clearly that the needs, problems, and interests of youth are not being met realistically; (3) that the changed nation and world today demand a revision of curriculums in keeping with a new culture; (4) that the United States accepts the ideal that mass public education is to be provided for all youths through the secondary level; and (5) that the continuation of democratic practices depends upon an educational system that creates citizens who think and act intelligently.

To maintain the role of education as a potent factor in a democracy education must continue to demand a program of reorganization which will assist youth to develop an integrated personality, to assume a successful place in group living, and to solve the everchanging problems of culture. A suggested procedure, the use of a core curricular structure, bases its reorganization on the common and persistent needs, interests, and problems of youth. Alberty describes this type of core curriculum as consisting of "broad, preplanned problem areas, from which are selected learning experiences in terms of the psycho-biological and societal needs, problems, and interests of students."[2] In the dissertation the author accepts Alberty's definition of the core curriculum and relates physical education to it.

The basic assumptions on which the study is conceived exemplify the primacy of physical education in today's pattern of living for all citizens. Therefore, the integration of physical education with education seems feasible if it provides the essential experiences which (1) create stable mental, emotional, and social attitudes in youths; (2) develop an inner security where emphasis in living is upon moral values; (3) emphasize the democratic ideal of respect for personality. Modern educational philosophy rests upon the psychological findings that the mental, emotional, and social aspects of human growth and development are inseparable. Therefore, educators must take cognizance of this fact in their plans for reorganization.

The study focuses its attention upon the vital contributions of the area of physical education to the problem areas of a previously structured basic core curriculum which encompases these assumptions. Contributory and supplementary activities of physical education, selected on the bases of a set of criteria, imply an expansion of or an alliance to the activities of the problem areas. These

two means of indicating an integrative process for the activities of physical education and of the core, although similar in selection, differ in relationship to the problem area: the former relates to the activities, the latter to the scope.

In the first approach the contributions that physical education makes to a specific suggested activity are stated in relation to a developed core program. No attempt is made to alter, to enlarge, or to add to the original activity. The area of physical education is merely searched for aspects which contribute to the specific activity as stated, even though the original activity is only suggestive.

In the second approach the area of physical education is considered in relation to the scope of the problem area where many harmonizing activities become evident. The activities emphasize the integration of the experiences of the student in the core program and the physical education area. They are closely allied to the scope of the problem area, yet go beyond the original suggestions to expand them into the area of physical education in relation to the two problem areas studied.

After extensive reading in the fields of philosophy, psychology, sociology, and physical education, the writer derived twelve concepts that seem applicable in establishing the possible integration of the field of physical education with the sixteen problem areas of a basic core curricular structure. The selection and the formulation of the concepts was a difficult task because of the vast amount of information the author had obtained through reading, research, and experience. Moreover, from the large number of concepts conceived, it was necessary to discard many irrelevant ones and retain only those in harmony with modern educational theory. The principles set forth by Williams,[3] Oberteuffer,[4] and Brownell[5] were the guides used in appraising the retained principles. Although a semblance of order evolved, each concept is an entity with no specific reliance upon the previous one or the one following. Yet, the twelve concepts are interdependent, so an hierarchical arrangement seems indefensible. Also readings confirm the hypothesis that physical education has a definite contribution to make to the problem areas of a core curriculum.

The problem areas selected for study by the three methods described are the Problems of Intercultural Relations and the Problems of Constructive Use of Leisure. Previous to the selection of the two problem areas, the author developed the 16 problem areas of the basic core curriculum through the formulation of a general summary statement and a detailed statement of experiences in order to arrive at a meaningful understanding of the areas. In the two selected, either a physical educator or a core teacher may find the contributory and supplementary activities practical and useable as stated. Also, the careful reader may note that the conceptual analysis of the two problem areas holds the concepts, the problem area, and the area of physical education thoughtfully in mind in developing the relationships; furthermore, these may direct and guide the sensitive teacher in assisting the students to meet their needs, to solve their problems, and to broaden their interests. Although the proposals are geared to a core program structure, they are still fundamental to the field of physical education wherever the activities of physical education are used to promote the development of the inner values essential to happy and successful living for the individual and for his group in society--values in human relationships for life in a democracy.

Scientific knowledge of man, of his environment, and of his interaction with his fellow men and his environment give credence to the following concepts. Each man's acceptance of and interaction with his environment create an unique individual. In his reaction man lives and acts as an unified whole, not in mental, physical, and emotional segments; therefore, it is possible to envision certain basic concepts of the integrated man. In no way does the writer infer that the twelve concepts presented in the study represent an exhaustive or an inclusive list of possible statements; they merely represent his preference. The concepts are applicable to education in a democratic culture, and thus, to physical education as an integral phase of the educative process for all youths.

1. Democracy is more than a form of government; it is a people's faith in a way of living that essentially embodies respect for personality.
2. Physical activity is a biological necessity for the growth and the development of children and youth, as well as for the continued well-being of adults.
3. Moral values are the foundation upon which a person bases his attitudes and behaviors to achieve exemplary living.
4. Purpose is a guide for the selection of experiences and for selection within the experiences of an individual and reflects personal values commingled with prior experiences.
5. Perceptual meaning coming from the experiences of the individual is a major directive for his behavior.
6. Assumptions, uniquely and continuously derived from the experiences of the human organism, are tentative guides for action.
7. The method of intelligence is implemented by critical, independent thought to enable a person to formulate mature guides to action.
8. Flexibility in patterns of living is essential for a person to meet contiguous situations readily, for life is a becoming process, novel and personal.
9. The emotional climate of experience is an eminent determinant of values, attitudes, and behaviors on which the inner security of the individual, and thus, his group welfare depends.
10. Leadership and followership abilities in group activity are paramount for youth to expand his ego, grow in worthy leadership, and assume a beneficent adult role.
11. Social attitudes and skills of an individual for group participation are indispensable in group living to give direction to human effort and to maintain a civilized state.
12. Cultural values evolved through an understanding of, a sympathy for, and an appreciation of the contributions of other races and creeds are vital to a citizen living in a world democracy.

To further the concept that students educated through an integrated curriculum should be qualified to act in a

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

mature manner and to lead satisfactory lives emotionally, physically, and socially, the writer offers the following conclusions:

1. Through the contributory and supplementary activities and through conceptual analysis, physical education has a definable and defensible contribution to make to the two explored problem areas of a basic core curriculum.
2. The derived concepts may form a valuable base for the evaluation of curriculum methods and materials in physical education, for the consideration and guidance function of the physical educator and for the appraisal of student growth toward maturity of judgment and action.
3. The concepts may serve to guide other fields of learning in exploring their possible contributions to a core curriculum.
4. A study of the concepts may widen and deepen the meanings of and the insights into the area of physical education.
5. The concomitant learnings in physical education may become more dynamic and significant through the integrative processes suggested.
6. The potency of the situations in physical education may help a youth to translate his values into overt behavior.
7. The three approaches to the contributions of physical education may have an analogous function in serving the needs, interests, and problems of youth.

The findings confirm the following hypotheses of the study: (1) that education may be more meaningful because of the contributions of physical education; and (2) that the role of physical education requires leaders who conceive a new breadth and depth in physical activities. This affirmation leads the author to the following recommendations for further activation of the integrative processes:

1. That the three approaches to the contributions of physical education to the core program be applied to all problem areas of a core curriculum.
2. That there be experimentation with the basic tenets of this study in a functioning core situation which is based on the activities of problem areas.
3. That there be experimentation with the first and the second approaches to the contributions of physical education as an operational base of cooperative action for the teacher in a problem area core and the teacher of physical education.
4. That there be experimentation with the third approach to the contributions of physical education to a core curriculum initiated by the physical educator assisted by the core teacher.
5. That there be experimentation relative to the effectiveness of learning in the area of physical education operating within the problem areas of a core curriculum.
6. That the study be explored for implications for the education of teachers both in the core and in the area of physical education.
7. That the concepts derived by the study be explored for possible guidance to the physical educator in expanding his vision of the area of physical education and of the core structure.
8. That there be further study of the integrative possibilities of physical education in reference to other core curriculums.
9. That all curriculums be concerned with a deeper penetration into the close relationship between the physical and all other areas of living as it functions in learning.

As a summary of the belief of the writer, and as a directive to the physical educator who holds the values and faiths expressed in the study, the writer quotes the inspirational statement with which Oberteuffer[6] closes his book, Physical Education:

> "Physical education taught in schools must answer many demands--of nature, of social need, of the culture of the time and place. The logic of these relationships is clear:
>
> If the democratic way of life is to be preserved,
>
> then
> Physical education programs must in every conceivable way instruct in democratic behaviors and demonstrate democratic procedures.
>
> If the individual in the democracy is to attain his fullest development,
>
> then
> From all of the world of science physical education must borrow and apply knowledge about the human organism, the way it develops, the hazards of its existence, and the conditions under which it thrives.
>
> If this development is to be effected through the means of organized education,
>
> then
> Physical education must plan, conceive, and execute its program in step with the best purposes and procedures of education and have no objectives different from those acceptable to education in a democracy.
>
> The development of any curriculum, therefore, or the solution of any problem, the instruction in any class, or the dealing with any student will be worked out within the above boundaries, and any deviation from the above charted course will be recognized at once as faulty practice."

Microfilm $3.10; Xerox $10.60. 240 pages.

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2. Alberty, Harold E. "Designing Programs to Meet the Common Needs of Youth," Adapting the Secondary-School Program to the Needs of Youth. Fifty-second yearbook of the NSSE, Part II. Chicago: University of Chicago Press, 1953, p. 120.
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Physical Education: Foundations and Principles. New York: McGraw-Hill Book Co., Inc., 1951.

6. Oberteuffer, op. cit., pp. 367-8.

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EDUCATION, PSYCHOLOGY

A STUDY OF THE EFFECTS OF CERTAIN VARIABLES UPON THE ATTITUDES AND OPINIONS OF THE CITIZENS OF A SUBURBAN COMMUNITY CONCERNING THEIR PUBLIC SCHOOLS

(L. C. Card No. Mic 59-5692)

Donald Keith Davidson, Ed.D.
Boston University School of Education, 1959

Purpose.-- The purpose of this study included two major aspects:

1. The adaptation of scientific survey methodologies to an economically feasible measurement of community attitudes and opinions concerning public education.
2. The determination of the effect of certain background variables, including sex, age, parenthood, length of residence, socio-economic status, occupation, amount and type of education, home ownership, and area of residence, upon the development of these attitudes and opinions.

Procedures.-- To fulfill the purposes of the study it was necessary to carry out the following procedures:

1. Determine the issues and the variables by consultation with a questionnaire committee composed of local professional and lay citizens.
2. Construct and pre-test the questionnaire.
3. Draw a domicile sample of 425 from the total adult population, stratified by population area densities.
4. Select and train thirty volunteer interviewers from the psychology classes of the local junior college.
5. Conduct the survey and collect the data.
6. Code the data for I. B. M. processing.
7. Compute the representativeness of the sample, the significance of differences, and the reliability of the results.
8. Interpret the findings and prepare the report.

Conclusions.--

1. The stratified sampling procedure, the questionnaire construction and the training of the volunteer interviewers appeared to produce a methodology for community attitude testing which was relatively inexpensive and sufficiently accurate to suggest wider application to local educational administration and policy making.
2. The attitudes of the citizens toward their public schools are summarized as follows:
   a. There was a high degree of satisfaction with the quality of the local public schools.
   b. There was a high degree of willingness to pay taxes to maintain this quality.
   c. There was a strong feeling that the public schools of the community gave equal or better preparation for college in comparison with the private schools.
   d. There was general expression of confidence in the conduct of the school committee and approbation in particular, of the construction of a second high school rather than concentration of all facilities in one large plant.
   e. The purposes and character of the community junior college seemed less familiar to the public than did those of the more traditional divisions of the public school system. There was a strong feeling that the students should continue to bear a portion of the cost through tuition payments.
   f. A majority expressed the opinion that the state and federal governments should bear a greater share of the cost of public education.
   g. A substantial segment felt that the average salary paid to teachers was too low.
3. The analysis of the different categories within the various background factors revealed the following:
   a. Males felt more favorable than females toward teacher salary increases.
   b. All socio-economic and educational levels expressed willingness to pay more taxes, if necessary, to maintain the quality of the local public schools, but there was a greater degree of willingness among the upper levels.
   c. Individuals with private school backgrounds expressed a very high degree of willingness to support the public schools and a high regard for their quality.
   d. The lower socio-economic classes expressed greater desire for continuance of the community junior college.
   e. Home ownership was not a discriminating factor in the degree of willingness to pay taxes.
   f. There were indications that the lowest socio-economic group did not feel as fully satisfied with the school program as the upper levels did. It was hypothesized that there was still a segment of the population to whom school did not represent a successful experience.
   g. The study illustrated that considerable caution is needed in generalization of survey results. Variable determinants must be carefully analyzed for elements of contamination and spuriousness.

There is a danger implicit in assigning causative relationships to impure variables.

Microfilm $2.95; Xerox $10.20. 227 pages.

THE DIFFERENTIATION OF FRESHMAN CURRICULAR GROUPS BY MEANS OF EMPIRICALLY DERIVED ACADEMIC INTEREST SCALES

(L. C. Card No. Mic 59-5624)

Robert Worth Filbeck, Ed.D.
University of Missouri, 1959

Supervisor: Robert Callis

Purposes:

(1) To construct and provide concurrent validation for interest scales from Strong Vocational Interest Blank (SVIB) items which will differentiate between division-by-sex classifications of college freshmen.

(2) To construct a "Verification Scale" (V-Scale) to detect random responding to the SVIB. The scales were to be composed of relatively few items and employ unit weights to simplify administration and scoring.

Collection of Data: The subjects were 513 male and 361 female freshmen volunteers; enrolled in the University of Missouri during the school years 1955-56 and 1956-57. They were administered the SVIB, in groups, following standard procedures.

Construction of the V-Scale: Selection of items for the V-Scale involved two steps, (1) determination of response-categories rarely responded to by freshmen in general and (2) also rarely responded to by the division-by-sex samples. Using a general sample of 192 freshmen, 103 response-categories were found to satisfy the criteria for "rarity." "Rarity" was determined by a contrast of obtained frequencies with chance frequencies for each response-category.

Validation of the V-Scale: The V-scores of 498 college students indicate that:

(1) University curricular groups are not differentiated by the V-Scale.

(2) Extensive differences are found between an obtained distribution of scores and a chance distribution of scores on the V-Scale (obtained mean = 9.09, chance mean = 34.3).

Inventories scoring above $\pm$ 3 SD's on the V-Scale were classified as "chance answered" and were eliminated from succeeding phases of this study.

Construction of the Curricular Interest Scales: Since only five division-by-sex samples contained the prescribed 75 or more subjects, curricular interest scales were not attempted for all possible groups. The male samples represented the colleges of Agriculture, Arts and Science and Engineering, female samples represented the colleges of Arts and Science and Education. Item analysis contrasted the response frequencies of the criterion group with those of a reference group having no representation from the criterion group. The contrast was by phi coefficient, with the .05 level the criterion for discrimination. Items were weighted plus one where a significant difference favored the criterion group, minus one where the reference group was so favored. Five scales, from 22 to 102 response-categories in length, were thus derived.

Validation of the Curricular Interest Scales: Concurrent validation of the scales involved tests of their ability to differentiate between criterion and noncriterion groups. Analysis of variance and t tests to determine the significance of obtained differences among groups scored on the same scale were employed with the .05 level the criterion for significance. A measure of overlap from a defined "zero point" was also employed. The criterion for validity here was a correct classification of contrasted groups significantly ($P < .05$) exceeding a random assignment.

Only the scales derived from the male samples satisfied the validation criteria, when applied to cross-validation samples.

Coefficients of correlation between the valid scales indicate the scales to be factorily unique. Also, when males are scored on all three scales and using standard scores, approximately 70 per cent will have their highest score on the own curricular scale.

Conclusions: These findings are highly encouraging for additional research into curricular interests. This is especially true in view of the simplified procedures shown by this study to be feasible. At their present stage of development and validation, the scales derived in this study have only limited uses in the academic counseling and advisory situation.

Microfilm $3.40; Xerox $11.60. 262 pages.

A STUDY OF THE RELATIONSHIPS BETWEEN ABILITY TO USE CONTEXT AS AN AID IN READING AND OTHER VERBAL ABILITIES

(L. C. Card No. Mic 59-5483)

Junior Eugene Fletcher, Ph.D.
University of Washington, 1959

Supervisor: Henry R. Fea, Ph.D.

For the mature reader, the general context, total word form, and detailed word parts all function in word recognition. While the role of total word form and detailed word parts in the recognition of printed symbols had been rather thoroughly studied, the importance of the contribution made by context to the whole perceptual process of reading had not been as systematically investigated. It was the purpose of this study, therefore, to gather data of a quantitative nature which would give more specific information as to the importance of the role played by ability to use context in word recognition.

To do this, the ability to use context of 174 University of Washington freshmen was measured using an adaptation of Taylor's "cloze" procedure. A test was devised using three reading selections, each approximately 250 words in length, in which every fifth word was replaced by a blank. The subjects were instructed to fill in the blanks with the words they thought belonged there on the basis of the surrounding verbal context. Scores were given on the basis of the number of blanks filled with words which matched those used by the author of the selection.

Reading abilities were measured with the Cooperative English Test, Reading Comprehension and the Rate of Comprehension Test, Dvorak-Van Wagenen Examination of Silent Reading Abilities. These provided scores for reading vocabulary, level of comprehension, and two rate of comprehension scores. In addition, the American Council on Education Examination of College Freshmen (ACE) was used to measure general verbal ability.

When test results were correlated, substantial relationships were disclosed between ability to use context as measured by the "cloze" procedure test and all of the tests of reading abilities and also the test of general verbal ability. The two tests designed to measure speed of comprehension, the Dvorak-Van Wagenen Rate of Comprehension Test and the Cooperative English Test, Speed of Comprehension, showed practically the same correlations with the "cloze" procedure test, .590 and .570, respectively, while their intercorrelation was .560. The Cooperative English Test, Level of Comprehension showed a correlation of .547 with the "cloze" procedure test while the Cooperative English Test, Vocabulary gave a correlation of .630. The highest correlation, .718, was between the ACE, Linguistic Section and the "Cloze" procedure test.

A study was made of the characteristics of the "cloze" procedure test, particularly to determine its reliability. Reliabilities calculated using both the Kuder-Richardson Formula 20 and a split-half technique were the same, .87, which also indicated a highly homogeneous test. An examination of the test items indicated a good spread of difficulty level and showed that almost all of them discriminated positively between low and high scorers on the test.

The substantial relationships between general ability to use context and reading abilities, as shown in this study, lent support to the conclusion that ability to use context as an aid in reading is a significant underlying factor in the reading proficiency of the mature reader.

It was recommended that the effects of variations in make-up, content, and method of administration of "cloze" procedure materials be further investigated; that studies be made at lower grade levels to gather information about the growth of ability to use context; and that similar studies using "cloze" materials and reading tests containing material closely comparable as to level of difficulty, type, and subject matter content be carried out.

Microfilm $2.50; Xerox $5.20. 104 pages.

A COMPARATIVE STUDY OF EMPLOYED MALE PHYSICAL EDUCATION GRADUATES AND PHYSICAL EDUCATION UNDERGRADUATE STUDENTS ON SELECTED INSTRUMENTS

(L. C. Card No. Mic 59-6482)

Joseph John Gruber Jr., Ph.D.
Purdue University, 1959

Major Professor: Dr. Lee E. Isaacson

This study was concerned with determining if successful male teachers of physical education who graduated from Purdue University and male undergraduate major students of physical education at Purdue University possess the same personality traits and attitudes towards teaching. Information of this type would be of vital importance in a selection and guidance program for prospective teachers of physical education. Two instruments were used to assess the variables of attitudes and personality. One instrument used was the Minnesota Teacher Attitude Inventory, hereafter referred to as the MTAI. The other instrument used was the Guilford-Zimmerman Temperament Survey, hereafter referred to as the GZTS, designed to measure ten traits of personality derived through factor analysis. The ten traits measured by this instrument are General Activity, Restraint, Ascendance, Sociability, Emotional Stability, Objectivity, Friendliness, Thoughtfulness, Personal Relations and Masculinity.

These inventories were administered to 203 physical education major students during their course in Educational Psychology, the first course in the professional education sequence on the Purdue Campus. The instruments were mailed to 112 successful teachers of physical education who agreed to participate in this study. In order to test various hypotheses, the teacher group was subdivided into a most successful (N = 35) and a least successful (N = 35) group by a jury of experts. The remainder were placed in a buffer group since the jury was hesitant to rate them as being most successful or least successful.

After compiling all of the data the following results were obtained:

1. Significant differences did not exist between all teachers and students when comparing scores on all ten traits of the GZTS and the MTAI.
2. Significant differences were not obtained when comparing most successful teachers with least successful teachers when employing these instruments.
3. Significant differences did not exist between most successful teachers and students when employing these instruments.
4. Significant differences were not obtained between least successful teachers and students when employing these instruments.

It was suspected that hidden behind mean scores were some items that might significantly differentiate between teachers and students. An item analysis confirmed this suspicion. A large number of items on the GZTS significantly differentiated between most successful teachers and students as well as between least successful teachers and students. Similar results were obtained from the item analysis of the MTAI. Here a large number of items also significantly discriminated between most successful

teachers and students as well as between least successful teachers and students.

All hypotheses were tested at the .05 level.

On the basis of the obtained results this investigator recommends that more research be conducted with these instruments by studying further the significant items and by actually exploring the possibility of developing a new inventory which will be of greater use in a selection and guidance program for prospective teachers of physical education at Purdue University. This investigator also recommends that this experiment be repeated at other colleges to see if similar results are obtained.

Microfilm $2.50; Xerox $6.60. 138 pages.

A STUDY OF CERTAIN PERSONAL CHARACTERISTICS AND ATTITUDES OF FULL-TIME AND PART-TIME STUDENT TEACHERS AND CERTIFIED BEGINNING TEACHERS

(L. C. Card No. Mic 59-6713)

William Douglas Hooker, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Royal B. Embree

The subjects chosen for study consisted of thirty-six elementary school student teachers and teachers. Twelve of the student teachers participated in the experimental fulltime student teaching program designed to enable school systems that had excessive increases in enrollment to use college seniors as teachers at a time when they were most needed. Twelve student teachers completed the regular part-time program at The University of Texas, while the remaining twelve persons were certified beginning elementary school teachers. Six student teachers or teachers from each group participated in the program during both the Fall and Spring semesters of the 1957-58 school year.

A Q Sort, A Sentence Completion Form, the Edwards Personal Preference Schedule, the Minnesota Teacher Attitude Inventory, and The Teaching Evaluation Record were chosen to be used in the evaluation of the study. In order to measure the attitudes, personal preferences, and teaching abilities of the student teachers and teachers, the instruments were completed twice during each semester--after the first eight weeks of the semester and again at the conclusion of the semester.

Analysis of variance was applied to the results. Insignificant differences were found among the three main groups with respect to their concept of self, the role of the teacher, and in their relationships with students and the community. Thus, the proposition that full-time student teachers would be more satisfied with their attitudes than part-time student teachers but less so than certified beginning teachers was not supported.

The results of the Sentence Completion Form, however, were significantly different and a second proposition, as it is directed to attitudes toward self, the role of the teacher, relationships with students and the community, was substantiated. The full-time student teachers were more positive in their attitudes than the part-time student teachers but not as positive as the certified beginning teachers.

There were no significant differences among the three groups for the discrepancy scores obtained by calculating the differences between the scores of the student teachers and teachers on the Edwards Personal Preference Schedule and the mean scores of twenty-five elementary school principals' conceptions of the "ideal" teacher. Consequently, with the exception of a number of slight changes in the direction of individual needs, a third proposition that full-time student teachers would be closer to the "ideal" teacher than part-time student teachers, but not as close as certified beginning teachers, was not supported.

There were significant differences in teaching abilities among the student teacher and teacher groups in that the full-time student teachers were more effective in their teaching abilities than the part-time student teachers and approximately the same as the certified beginning teachers.

Similarly, significant differences were found in the attitudes, personal preferences, and teaching abilities of the three groups and the proposition that full-time student teachers would be closer to certified beginning teachers than to the part-time student teachers was supported.

There were considerable data to support the proposition that student teachers and teachers become more positive and move closer to the "ideal" in their attitudes and personal preferences and improve in their teaching abilities during the course of a semester.

The results of the study were interpreted in terms of their importance to student teaching programs. Implications and suggestions for future research were discussed.

Microfilm $2.50; Xerox $7.40. 156 pages.

AN ANALYSIS OF SELF PERCEPTIONS IN COUNSELOR TRAINEES

(L. C. Card No. Mic 59-6716)

Raymond Carroll Kenney, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Royal B. Embree

The purpose of this investigation was to determine the extent to which real self and ideal self perceptions in counselor trainees: (1) varied in five replicated self and ideal ratings obtained during a period of training, and (2) were related to changes in personality characteristics occurring between pre-training experiences and post-training experiences as measured by The Guilford-Zimmerman Temperament Survey (GZTS) and The Edwards Personal Preference Schedule (EPPS). In addition, the composite real self ratings of individual trainees were correlated and the resultant matrix factor analyzed using the quartimax solution.

The population for the study consisted of twenty-four counselor trainees enrolled in an advanced practicuum course at The University of Texas. Three experimental comparison groups, consisting of eight trainees per group, were identified on the basis of mean self and ideal r's obtained from Embree's Q-sort (EQS). The comparison groups were operationally defined as High, Middle, and Low self concept groups.

The analysis of variance revealed significant changes in self and ideal perseptions occurred during the training

period for all three comparison groups. Also, significant changes occurred according to rating period. High and Middle comparison groups tended to decrease the discrepancy between real self and ideal self ratings as training progressed. The Low comparison group showed an initial decrease in discrepancy between self and ideal ratings, followed by an increase which continued throughout the remainder of the training period. No significant differences between comparison groups were obtained on the EPPS. For the entire population, however, Deference and Endurance scores decreased significantly between test periods, and Heterosexuality scores increased. On the GZTS, Low comparison group scores were significantly lower on variable S than were Middle and High comparison groups scores, but no significant changes in scores occurred between test periods. No other changes in GZTS scores were significant. Factor analysis of the real self intercorrelation matrix identified five subgroups of trainees. The factors were identified as follows: I. Counselor Stereotype; II. Objective-Analytical Counselor Type; III. Defensive-Supportive Counselor Type; IV. Permissive Counselor Type; and V. Objective-Permissive Counselor Type. Item analysis indicated that, in general, trainees in subgroups agreed on characteristics least like themselves in the counseling relationship, but varied in self perceptions which were most characteristic of themselves in the counseling relationship.

The results were interpreted as a contribution to self theory and to further understanding of modifications in personality which occur in counselor trainees during a training experience. Implications and suggestions for future research were discussed.

Microfilm $2.50; Xerox $6.60. 139 pages.

RESIDENCE-MATE'S PERCEPTIONS OF BEHAVIORAL CHANGES IN PERSONS FOLLOWING GROUP DISCUSSION

(L. C. Card No. Mic 59-6722)

John Michael Newell, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Oscar Berry Douglas

The purpose of this study was to ascertain if changes in the emotional maturity of individuals who had participated in a group discussion experience could be perceived by their peers. A secondary purpose was to ascertain if changes in the emotional maturity of these individuals would be reflected in self-ratings. The research population was two classes of student nurses. The entire membership of the Freshman and Junior classes were used with each class being treated as a separate research sample. Each subject was asked to respond to a rating scale which required that every subject rate each other classmate in terms of how she would feel about working with each classmate on a co-operative work project. Six subjects from each class were chosen from those who had volunteered to participate in the group discussion experience as clients. Six other subjects, each of whom had rated a different client as "like" on the rating scale, were designated as the residence-like group while the six remaining subjects, each of whom had rated a different client as "dislike" on the rating scale, were designated as the residence-dislike group.

In addition to the scores on the rating scale, pre-discussion and post-discussion ratings were obtained on a scale of emotional maturity and two Q-check instruments, "The Person I Am," and "The Person I Would Like To Be." Each client was rated by both groups of residence-mates, and each group of residence-mates was rated by its corresponding client and member of the other residence-mate group. A post-discussion rating of change in ability to express and accept feelings toward her classmates was made by the group leader. The client group was rated as "improved" or "non-improved."

The data were analyzed to determine if there were changes in rating from pre-discussion to post-discussion. The statistics used were analysis of variance and non-parametric tests of significance of differences. Changes in the ratings of the clients by each residence-mate group and changes in rating of each residence-mate group by clients and other residence-mates were analyzed for significance of differences.

No significant differences in rating of emotional maturity were found for any group. The residence-dislike group for the Freshman class rated the clients as being less emotionally mature while the residence-dislike group for the Junior class rated the clients as being more emotionally mature, although these differences were not significant from pre-test to post-test. Self-ratings of emotional maturity showed no significant changes from pre-discussion to post-discussion. The self-ratings on the two Q-check instruments indicated that the subjects preferred an authority-oriented social structure. A significant shift in preference from an authority-oriented to an ambivalent-oriented social structure was found although there was no evidence that this shift was significant for the client group. There were significant differences between pre-discussion and post-discussion ratings of the "improved" clients by the residence-dislike group on the scale of emotional maturity. The post-discussion rating indicated a decrease in emotional maturity for this client group.

Other conclusions as well as suggestions for further study also are reported.

Microfilm $2.50; Xerox $4.80. 94 pages.

AN EVALUATION OF THE CONTRIBUTIONS OF FOUR SELECTED PERSONALITY FACTORS TO THE PREDICTION OF FIRST QUARTER GRADES OF UNIVERSITY OF GEORGIA FRESHMEN IN SELECTED CURRICULAR AREAS

(L. C. Card No. Mic 59-5685)

Alice Pearl Nix, Ed.D.
University of Georgia, 1959

Supervisor: Joseph C. Bledsoe

Problem. The problem in this study was to determine to what extent four personality factors identified as Achievement Motivation, Self Concept, Self-Ideal Concept, and the Discrepancy score contribute to the prediction of marks of University of Georgia Freshmen in fifteen selected curricular areas.

Procedures. Since a double cross-validation research design employing Pearson product-moment correlations was used, the total group of 955 entering Freshmen was divided into two stratified random samples having equal proportions of man and women. The t-test of the reliability of the differences between means showed that the two samples did not differ significantly with regard to selected measures of scholastic aptitude and achievement.

Prior to admission, each subject was administered the College Entrance Examination Board Scholastic Aptitude Test (SAT). During Orientation Week (September 1958), each subject was administered the following tests: Cooperative College Ability Test (SCAT), Cooperative Reading Comprehension Test, the University of Georgia Algebra Placement Test, and the research instrument (Index of Study and Work Habits) which yielded four scores: Achievement Motivation, Self Concept, Self-Ideal Concept, and Discrepancy score (the difference between the Self Concept and Self-Ideal Concept ratings). The academic marks in the selected curricular areas were obtained from the Registrar's Office and all data were punched into IBM cards to facilitate the statistical computations.

Pearson product-moment correlations between the thirteen selected prediction variables and the criterion variables (marks in fifteen curricular areas) were computed for the two samples and total group of men and two samples and total group of women. Coefficients from the total groups were used in the analyses of multiple regression.

Because of their relative superiority as predictors, SCAT-Total and High School Average were chosen from the intellective predictors and Achievement Motivation and Self-Ideal Concept from the personality factors for the analyses of multiple regression of marks for males and females in the selected curricular areas.

Findings. The Achievement Motivation score was significantly related to marks assigned men in English 101, Mathematics 100, the social sciences, Political Science 1, the fine arts, and first quarter average and to marks assigned women in English 101, the social sciences, Political Science 1, Speech 8, the fine arts, education, and first quarter average. The Self Concept rating was significantly related to marks assigned men in the foreign languages, fine arts, and fall quarter average but not to marks for women. The Self-Ideal Concept rating showed significant correlations with the marks of men in English 101, Political Science 1, the fine arts, and first quarter average and to marks of women in English 101, Mathematics 100, and first quarter average. The Discrepancy score was not significantly related to the marks of either men or women.

The analysis of multiple regression showed that Achievement Motivation and the Self-Ideal Concept made considerable contributions to the regression of scores in the several curricular areas. For men, Achievement Motivation contributed from 9 to 57 per cent of the regression of marks in agriculture, Political Science 1, the social sciences, and the fine arts, whereas for women, it contributed from 12 to 78 per cent in the social sciences, the fine arts, Speech 8, Political Science 1, education, and Mathematics 99. For men, the Self Concept contributed from 12 to 33 per cent of the regression of scores in agriculture, the fine arts, and Mathematics 99, while for women, it contributed about 16 per cent of the regression in Mathematics 99 and the fine arts.

Conclusion. The personality factors investigated contribute unequally to the prediction of marks for men and women in the fifteen selected curricular areas, making the greater contributions to the regression of scores in the professional courses and the smaller contributions in the required courses such as mathematics, English, natural sciences, and foreign languages.

Microfilm $3.25; Xerox $11.00. 249 pages.

A VALIDATION STUDY OF SELECTED TESTS FOR POSSIBLE USE IN ADMISSION TO PROFESSIONAL EDUCATION SEQUENCES AT PURDUE UNIVERSITY

(L. C. Card No. Mic 59-6504)

John Raymond Palacios, Ph.D.
Purdue University, 1959

Major Professor: Lee E. Isaacson

The purpose of this study was to investigate the validity or predictive efficiency of a battery of tests selected by the Committee on Selection and Guidance at Purdue University. The battery consists of the Minnesota Teacher Attitude Inventory, the Nelson-Denny Reading Test, the Guilford-Zimmerman Temperament Survey, the Purdue Mathematics Training Test, and the New Purdue Placement Test in English. The first year grade-point index was added as a predictor variable. The above constituted seventeen variables for use in predicting scholastic achievement.

The three criteria of scholastic achievement included an education grade-point index, a major area grade-point index, and the total grade-point index at the time of graduation.

The sample studied consisted of students who were enrolled in an introductory educational psychology course, who graduated and who met certain specified requirements, prior to graduation. There were 105 females, 159 males, for a total of 264 subjects.

All intercorrelations of the seventeen predictor variables and the three criteria for the males, females, and total group were computed using the product-moment coefficient. A multiple correlation for each of the criteria with the seventeen predictor variables was determined using total group data (.631 with education index, .699 with major index, .881 with total index). The Wherry-Doolittle technique was used to obtain several regression equations for each of the three criteria of scholastic achievement.

The results of the statistical analyses indicate that the best single predictor of future academic success was past academic achievement as measured by the first year grade-point index (.532 to .855). Some of the personality and attitudinal variables, when used in conjunction with the first year grade-point index, were able to enhance the predictive efficiency as indicated by the various regression equations. The Restraint (.268 to .336) and Personal Relations (.314 with education index) scales of the Guilford-Zimmerman were among the more prominent contributors. Communicative skills and comprehension of English as measured by the New Purdue Test in English (.382 to .494) and the Nelson-Denny Reading Test (.286 to .384) also contributed to the efficiency of the prediction equations

emphasizing the fact that these skills are fundamental to academic or scholastic success.

The results indicate that the present battery can contribute valuable information for purposes of research, prediction, and individual guidance and counseling.

Microfilm $2.50; Xerox $6.20. 129 pages.

A COMPARISON OF ATTITUDES AND VALUES EXPRESSED BY MENNONITE AND NON-MENNONITE COLLEGE STUDENTS

(L. C. Card No. Mic 59-6608)

Frank C. Peters, Ph.D.
University of Kansas, 1959

Mennonites are Anabaptists and form a religious and cultural minority group in the United States. They tend to settle in "closed" communities and attempt to foster social, economic and religious values of their own. To do this, they often maintain private schools.

Three objectives were set for this study, namely: (1) to compare the attitudes and values of Mennonite college students with those of non-Mennonite college students; (2) to compare the attitudes and values of Mennonite college students who had graduated from a Mennonite private high school with those of Mennonite college students who had graduated from a public high school; and (3) to compare the attitudes and values of Mennonite college students of the three major branches of the Mennonite church. The comparisons were made on the basis of the responses to items of a prepared questionnaire, the Bogardus social-distance scale, and the Allport, Vernon and Lindzey scale for the study of values.

The data from two matched groups of 200 Mennonites and 200 non-Mennonites were analyzed and yielded the following general conclusions:

1. Of the fifteen statements concerning marriage and related subjects, Mennonites differed significantly from non-Mennonites in their responses to nine statements. Mennonites tended to display greater agreement with statements which involve religious precepts.

2. Mennonites differed significantly from non-Mennonites in the ranks assigned to certain traits deemed desirable in the choice of a marriage partner. "Shares my religious beliefs" was given first rank by almost twice as many Mennonites as non-Mennonites. On the other hand, almost twice as many non-Mennonites as Mennonites gave "Intelligent--common sense" first rank.

3. With respect to the matter of divorce, Mennonites differed from non-Mennonites in their responses, to eleven of the twelve statements. Mennonites were less ready to accept the various commonly recognized grounds for divorce.

4. With reference to inter-faith marriages, Mennonites differed from non-Mennonites in that Mennonites were less ready to agree that there could be a satisfactory marriage between Jew and Gentile, Catholic and Protestant, and Protestants of quite different faiths.

5. Of the six statements concerning the matter of married women working, there were significant differences between Mennonites and non-Mennonites on three. Mennonites were less ready to accept the fact that married women should work outside the home.

6. Mennonites differed significantly from non-Mennonites in their responses on three of the six measures of the Allport, Vernon and Lindzey scale for the study of values. Mennonites scored lower in theoretical and political values, and higher in religious values than did non-Mennonites. No significant differences were found with respect to economic, aesthetic, and social values.

7. Mennonites showed significantly more social farness than did non-Mennonites in responses to twenty-six of the thirty ethnic groups used in the social distance scale.

8. Mennonites showed significantly more social farness than did non-Mennonites in response to thirty of the thirty-four religious groups used in the social distance scale.

The data from two matched groups of 47 Mennonites who had attended a private church-related high school and 47 Mennonites who had attended a public high school were analyzed and revealed that there were no major statistically significant differences in their responses.

The data from three unmatched groups of Mennonite students belonging to three of the major Mennonite bodies in America were analyzed and yielded the following significant differences:

1. Old Mennonites differed significantly from the other two groups with regard to their ranking of the trait "Of the same race as I (specifically not a Negro)." Fewer Old Mennonites than students of the other two groups ranked this as the number one consideration in choosing a marriage partner.

2. Old Mennonite students were less ready than stuents of the other two groups to agree that there could be a satisfactory marriage between Protestants of quite different faiths.

3. With reference to the Allport, Vernon and Lindzey scale for the study of values, the Mennonite Brethren students showed significantly higher economic scores than did the other two groups. Mennonite Brethren students showed significantly lower social scores than did the other two groups. Old Mennonites showed higher religious scores than the other two groups and lower political values than the other two groups.

Microfilm $2.85; Xerox $9.80. 220 pages.

PERSONALITY TRAITS OF HIGH-ACADEMIC ACHIEVERS AT OKLAHOMA BAPTIST UNIVESRITY, 1958-1959

(L. C. Card No. Mic 59-5498)

Coleman LaVan Raley, Ed.D.
The University of Oklahoma, 1960

Major Professor: Dr. Henry Angelino

The purpose of this study was to isolate the non-intellectual personality traits of high academic achievers in the College of Liberal Arts of Oklahoma Baptist University.

Subjects: Group I - 55 high achievers who earned a quality-point average of 3.5 or above on a 4.0 scale matched for sex, academic classification and academic ability as

measured by the ACE Psychological Examination with Group II - 55 moderate achievers who earned a quality-point average of 2.0 - 2.5. Sub-groups A and B consisting of the upper and lower 27 percents of each group in academic ability as measured by the ACE.

The Data: The Edwards PPS, which measures Achievement, Deference, Order, Exhibition, Autonomy, Affiliation, Intraception, Succorance, Dominance, Abasement, Nurturance, Change, Endurance, Heterosexuality, and Aggression; the AVL Study of Values, which measures Theoretical, Economic, Aesthetic, Social, Political, and Religious values; and the Strong VIB for Men from which Occupational Level, Specialization Level, Masculinity-Feminity, and Interest Maturity were obtained, were administered to Groups I and II. Answer sheets were IBM machine scored.

Treatment: Subject of Groups I and II were compared on each of the 25 variables measured holding the factor of sex constant and with the sexes combined. Each sub-group was compared with every other sub-group. A total of 11 comparisons were made on each of the 25 variables. Median tests and the X^2 technique were applied.

Findings:

1. High-achieving students score significantly higher than moderate-achieving students on the Occupational Level scale of the Strong VIB ($P/.05$) indicating greater similarity of interests to managerial and professional persons.

2. High-achieving female students score significantly lower on the Change scale of the Edwards PPS ($P/.05$) and higher on the Interest Maturity scale of the Strong VIB indicating more mature and more stable interests and less need to change activities frequently.

3. High-achieving moderate-ability students (IB) have higher Deference and lower Dominance needs than either of the other 3 sub-groups (P's .001 to .05) suggesting that "over-achievers" conform more readily to accepted practices and assume leadership roles less readily.

4. High-ability students, regardless of their achievement levels, (IA and IIA), score consistently higher than moderate-ability students on the Specialization Level scale of the Strong VIB indicating that this scale is more closely associated with ability than achievement.

Recommendations:

1. A larger number of subjects sub-divided into groups relatively homogeneous with regard to academic ability should be selected from similar institutions for study utilizing the scales that reveal differences in this study.

2. An item analysis of the Edwards PPS in order to determine which items differentiate between the various groups and sub-groups would be valuable.

Microfilm $2.50; Xerox $4.40. 81 pages.

A STUDY OF OUTCOMES OF INSTRUCTION IN A PSYCHOLOGY CLASS WITH SPECIAL REFERENCE TO TWO TEACHING METHODS

(L. C. Card No. Mic 59-6636)

John Paul Smith, Ph.D.
The Ohio State University, 1954

BACKGROUND

Psychology has been a part of the professional preparation of teachers since the earliest days of the normal schools. Many people concur in the opinion that it is essential to teacher preparation, and it is a frequent requirement for certification as a teacher. There is scarcely any other point of agreement regarding the course. There is great variety in course content, instructional methods, level at which the course is presented, and the like. This lack of agreement creates obstructions to attempts to make a general evaluation of the merits of psychology in the preparation of teachers.

Since there is this difficulty in making a general evaluation it would seem desirable to make local evaluations. This is desirable for three major reasons:

1. Thorough evaluation shows the actual outcomes of instruction.
2. The effect of a given instructional activity may be determined by a study of the outcomes.
3. Relationships between certain characteristics of the students and the course outcomes may be discovered.

The objectives of the present research project are indicated by these three functions: (A) to make a general course evaluation, (B) to find the influence of a specific instructional activity, and (C) to find relationships between certain student characteristics and some course outcomes.

OTHER STUDIES ON THE TEACHING OF PSYCHOLOGY

For convenience, research studies may be classed in one of three categories: (A) studies utilizing the class as an agency for group therapy (including socialization), (B) comparisons of the so-called instructor-centered and student-centered methods of instruction, and (C) evaluations of some particular instructional technique. Faw[1] describes the first of these. Eglash[2] has published a study recently of the second type, and Klausmeier and Swanson[3] have a very comprehensive report of the third type.

All of these research reports affirm the value of careful study of course outcomes; all support the conclusion that educational psychology can be made vital in teacher preparation; and most either assert or imply that a laboratory or practicum approach will be most advantageous in terms of transfer to a teaching-learning situation with children.

Two general criticisms apply to these studies. First, only rarely have follow-up studies been reported. Secondly, there has been no attempt made to relate teaching activities to student characteristics. The reader is left to infer that the reported instructional activity is equally efficacious with all students. This is, of course, hardly conceivable. In the present study the attempt has been made to avoid these shortcomings.

SUBJECTS, PROCEDURES, AND SOURCES OF DATA

The 178 subjects used in the present research project were regularly enrolled students in the College of Education of The Ohio State University. All were taking Educational Psychology 407, one of a sequence of courses for the professional development of teacher candidates. They were of all class ranks with a majority being sophomores. There were 51 males and 127 females. Of the males, 5 were Elementary Education majors and 46 were majoring in Secondary Education. Fifty-nine of the females were Elementary and 68 were Secondary Education majors.

The students were taught in six sections of approximately 30 students each by three Graduate Teaching Assistants in the Department of Psychology. Three of the sections met at the same hour, 9:00, while the other three met at different hours. Each instructor taught one of the 9:00 groups and one other.

The basic procedure for collecting data was the administration of tests of various sorts at the beginning and again at the end of the quarter. The data were variously combined and analyzed in order to furnish information for each of the objectives.

Data used in the project were taken from the following sources: an objective type achievement test constructed by the writer; an attitudes survey constructed by the writer; a Teachers' Self-Analysis Checklist;[4] four subtests of the Guilford-Zimmerman Temperament Survey;[5] students' reports of cumulative point-hour ratio; Report of Test Percentiles (published by the Occupational Opportunities Service of The Ohio State University); and, grades in Educational Psychology 407 based on four objective achievement tests. These devices represent a selection, from measuring techniques available, imposed by the necessity of conducting classes with a minimum of interference.

The procedure followed in treating data for two of the objectives of the project (general evaluation and assessing the influence of a specific instructional activity) was that of testing for differences between mean scores and variability of groups. This was done either for the same group from the beginning to the end of the quarter, or for different groups at the beginning and again at the end of the quarter. The experiences of the enrollment in the course are considered as "interpolated" between these tests. The statistical technique of Chi square was used for the third objective, that of finding relationships between student characteristics and course outcomes.

FINDINGS

Objective one: General outcomes of instruction.—Increased knowledge of psychology is one important objective of the course. Changes in knowledge were sampled by a 100-item objective test given at the beginning and again at the end of the course. The gains which occurred were at a high level of statistical stability. The liklihood that they might be duplicated merely by chance was less than 1 in 10,000. It is noteworthy that some students' pretest scores were superior to the mean score on the same test given again at the end of the quarter. This is not a unique finding, having previously been noted by Worcester,[6] Learned and Wood[7] and Lynch [8] One desirable instructional practice in taking account of these individual differences is to allow the most able students to receive credit by examination.[6]

A second course objective is the improvement of attitudes toward the course and toward psychology in general. No real change occurred; the obtained gain was one that might be equalled by chance alone in 85 of 100 trials. This outcome is judged to be the result of the instructors' failure to recognize attitude change as an important course objective.

Another important course objective which is of interest in the research is to create changes in the students' appreciation of teaching which are of such a nature that the students can be said to have an increased psychological sophistication about their future teaching duties and relationships with children. This change in the students can be best conceived as increased willingness to try to understand human behavior by reference to psychological principles of widely accepted generality. The attainment of this objective is indicated by a comparison of the sub-test scores of the Teachers' Self-Analysis Checklist given at the beginning and end of the quarter. Gains which occurred would scarcely be duplicated by chance alone once in ten-thousand trials.

Three instructional activities of Educational Psychology 407 seem to be related to this outcome: (1) use of a series of prepared case studies, (2) a paper describing two kinds of personal experiences--constructive and destructive--which were caused by some teacher, and (3) many discussions accompanying these and other class experiences. These discussions are oriented toward showing the relevance of psychological principles for understanding behavior.

Briefly, the first objective of the research has been met. A general evaluation shows that students made gains in knowledge and in greater understanding of the role of psychology in their future teaching duties and relationships with children. However, sought-for gains in attitudes toward the course did not occur.

Objective two: Comparison of the instructional methods, lectures and discussion.—Preference for one or the other of these methods seems to be associated with educational aims of the one doing the research. Thus, those who believe the primary function of a class is subject-matter acquisition prefer the lecture as a method of instruction. Those who see the class as primarily a socializing or therapeutic agency uphold the many discussion techniques as the superior type of instruction. The issues of excellence of instruction and economy of instruction are probably the source of interest in this problem.

In the present project three sections of students received a series of nine lectures given by a senior member of the Department of Psychology at The Ohio State University, Professor John E. Horrocks. The other three sections had the usual discussion or other activity during these periods. In the judgment of the instructors the lectures constituted a distinct difference in the treatment of the classes, but there were no other gross differences in instruction for the groups.

Comparisons of combined lecture and nonlecture groups, and of individual lecture and nonlecture groups, and study of the respective amounts of gain on the several measures of outcomes all lead inescapably to the conclusion that there were no discernible differential consequences of the two instructional methods. It seems possible, judging by this finding, that method per se is probably not central in determination of outcomes except perhaps in therapy classes. The most important factors have yet to be defined.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Objective three: Student traits related to course outcomes.—Failure to relate course outcomes and student characteristics was a shortcoming of previous studies in the evaluation of an educational psychology course. In the present project students were arbitrarily divided into, usually, three groups by their status on a given trait and then compared on other traits and course outcomes. The method of Chi square was used to test hypotheses either of association or of no association. As an example of a situation in which no association was predicted, students divided into high, average, and low groups by their scores on the achievement pretest were not expected to fall into the same groups (or into inverse relationships) by their scores on the attitudes test. However, they were expected to fall into much the same groups when achievement test scores and cumulative point-hour ratio were compared. As a rough test of this procedure, the expected associations were found and it was then assumed that other existing but unsuspected associations would also be discovered by this method.

The findings for this research objective may be very briefly summarized. Sex and class rank, often thought to be associated with course outcomes, were discovered to be unrelated to measures of outcomes used in this study although there was a tendency for relationship between these characteristics and academic achievement. Cumulative point-hour ratio was related only to knowledge of subject-matter. Academic aptitude test score and an achievement pretest were also related to this outcome. Any one of the three characteristics might be used in future studies in which it would be desirable to match or equate students, whereas sex and class rank seem unimportant. Major area was related to two of the sub-tests of the Teachers' Self-Analysis Checklist, with the Elementary Education majors having the superior scores. One subtest of the Guilford-Zimmerman Temperament Survey, Sociability, was related to performance on the Checklist, thus affording another possible measure for the guidance of students. Generally speaking, measures of intellectual ability were not associated with temperament or personality variables or with the several sub-tests of the Checklist.

Additional data: Follow-up study.—It was hoped that there might be some means of estimating the permanence of outcomes in Educational Psychology 407. All students who had been in the original group and who were still enrolled in the Spring Quarter, 1954 were contacted. Only 18 responded with more data, a retest of the attitudes measure and the Teachers' Self-Analysis Checklist. There was a loss in score on the former and on all five sub-tests of the latter, but the relative position of these students did not change greatly. By and large, the high scoring students of March, 1953, were still the higher in June, 1954, and the low scoring students kept their positions also. The small sample militates against generalization, but it would seem to be a matter of considerable importance to check this finding with further studies.

IMPLICATIONS OF FINDINGS FOR TEACHING THE COURSE

Increasing students' knowledge of subject-matter is, of course, recognized as very desirable. Sometimes, however, there is doubt that it is possible to increase students' appreciation of the relevance of psychological principles for a deeper understanding of teachers' duties and relationships with children. Both outcomes are possible as this study shows. Possibly, in teacher preparation, it would be desirable to give equal weight to both outcomes in assigning students' grades.

Also instructive for improvement of the teaching of Educational Psychology 407 was the lack of any attitudes gain. It seems likely that this failure was the result of a prior failure clearly to present attitude change to the instructors as an important course objective. Therefore, objectives should be clearly stated, preferably in everyday language and not in flowery generalities, and they must be so defined that it is possible to measure in some way the degree of their attainment.

Another point—not new, but certainly of vital importance—is that it is necessary to take account of individual differences if objectives are to be attained by all students. An almost staggering range of differences which were directly related to important course outcomes existed among the subjects of this research. One trait which is so related is academic ability. Some of the students probably would not be distinguished from high school seniors and found the course content too complex to grasp and retain. Others were bored by what was for them a slow pace and elementary level of content. There were also great differences in knowledge of the subject-matter prior to taking the course. Some students who had learned from their prerequisite course knew more at the beginning of the course than the majority of Educational Psychology 407 students did at the end of the quarter. Another type of individual difference was in attitudes toward teaching. Some of these education majors were quite antagonistic toward the teaching profession or various aspects of it.

These three differences, ability, knowledge, and attitudes—and probably others as well—are apparently directly related to students' ability to learn, need to learn, and willingness to learn. Perhaps students should systematically be appraised on these characteristics at the beginning of each term, with beneficial results for the students as the instructional methods and course content are revamped to meet the existing conditions.

IMPLICATIONS OF FINDINGS FOR FURTHER RESEARCH

A continuing need is refinement and validation of measures. This is especially true since such results as those obtained in the follow-up data indicate that there are enduring characteristics which, very possibly, are related to teaching effectiveness. It seems desirable that any means of measuring any aspect of teaching ability should be exploited to the fullest possible extent.

In carrying out research similar to this project, one difficulty is that it is expensive in time and effort. Fortunately, there are ways of increasing the returns from the effort expended. The study has shown that certain traits are relevant and others unimportant for this type of research; hence, stratified sampling could be used. This reduces the number of subjects needed, and this, in turn, would allow carefully controlled research which would not disrupt the work of many students while at the same time allowing considerably greater variation in experimental conditions.

Paralleling these experimental investigations, it should be possible to continue to study relationships between

student characteristics and course outcomes in a very inexpensive manner. The addend system devised by Toops[9] for identifying "ulstriths" (groups which are unique in some psychologically significant way) could be used for this purpose with most of the work being done by the students. An obvious advantage of this suggested project is that it would provide data, objective data, on various characteristics and competencies which could later be related to success in teaching and to student selection and guidance. Information routinely collected and recorded at the present time might be utilized for this purpose.

CONCLUSION

The present research had three objectives, a general evaluation of outcomes of instruction in Educational Psychology 407, a comparison of the relative influence of different instructional methods on the outcomes of the course, and identification of student traits and characteristics related to course outcomes. These objectives have been attained. Some contributions of Educational Psychology 407 to teacher preparation at The Ohio State University have been noted. It is hoped that some useful suggestions for the teaching of Educational Psychology 407 and for future research may be derived from the project.

Microfilm $2.50; Xerox $5.20. 102 pages.

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A STUDY OF THE FUNCTIONS OF PERSONNEL DEANS IN INSTITUTIONS OF HIGHER LEARNING IN THE STATE OF NORTH CAROLINA

(L. C. Card No. Mic 59-6450)

Beverley Brown Swan, Ph.D.
The University of North Carolina, 1959

Supervisor: William D. Perry

This investigation was undertaken to discover whether or not some concensus could be reached concerning the role and functions of the non-academic dean in colleges and universities in North Carolina. The convenient generalization, personnel dean, is used to denote those administrative officers who carry major responsibility for students' personal and social welfare.

The colleges which were selected for study include the thirty-four, four-year, degree-granting institutions which are members of the North Carolina College Conference. Twelve are state-controlled and twenty-two are church-related. They range in size from an enrollment of 225 students to one of 7,510 students. The study was conducted on a face-to-face interview basis. Every campus was visited; fifty-six personnel deans were interviewed.

The interviews were structured on the basis of an Interview Schedule, which contained eleven simple data items and forty-seven questions which related to the duties of the personnel deans.

After the data were compiled, it was found that there were certain areas of comparability of function among the fifty-six personnel deans who were interviewed.

In the area of selecting students and of starting them toward successful adjustment to college life, it was found that one-half of the personnel deans had some responsibilities for the screening of prospective students; seventy per cent carried responsibility for deciding who shall be admitted to the college. Eighty-seven per cent of the deans carry major responsibilities for orienting freshmen to student life.

In regard to relationships with students, most personnel deans are responsible for counseling: ninety-five per cent are responsible for personal counseling; fifty-nine per cent are responsible for educational and vocational counseling; eighty-six per sent are responsible for counseling those students who are on academic probation. With extra-curriculum activities, fifty per cent of the deans carry responsibilities for student religious activities; ninety-five per cent report heavy responsibilities in the area of all student activities, including student government. Ninety-one per cent of the deans are responsible for student discipline.

Student housing is one of the areas of major responsibility for personnel deans: ninety-one per cent assign students to dormitory rooms; seventy-six per cent are responsible for roommate changes. All personnel deans except one employ and supervise dormitory counseling staff. Thirty-three per cent of the men deans live in dormitories with students; fifty-eight per cent of the women deans live in dormitories with students. Directly related to responsibility for housing is responsibility for food services: forty-four per cent of the deans carry responsibilities in this area. Another related area is that of student health: fifty per cent of the deans carry responsibilities for student health services.

Personnel deans are usually responsible for the financial welfare of students. Sixty-four per cent carry responsibilities for the awarding of scholarships; sixty per cent are responsible for the granting of student loans; fifty-eight per cent help students find part-time employment.

Non-academic deans are customarily considered both administrative officers and faculty members of the institutions which they serve. Sixty-nine per cent of the deans have responsibilities for college-wide policy-making decisions. Fifty-seven per cent of the deans carry an instructional load and ninety-one per cent serve on faculty committees.

Further research in this area seems to be indicated to determine whether or not the duties and functions of personnel deans in North Carolina conform to those of deans in other states in the nation.

Microfilm $2.50; Xerox $8.60. 188 pages.

STUDENTS OF HIGH ACADEMIC POTENTIALITY AND THEIR SATISFACTION WITH COLLEGE EXPERIENCES

(L. C. Card No. Mic 59-6016)

Ruth Elfrieda Westlund, Ph.D.
University of Minnesota, 1959

Problem

The study was designed to measure reactions of students to their college experiences and to study the relation of satisfaction to potentiality, college achievement, and sex. It was made in May, 1957, when the selected freshmen in the College of Science, Literature, and the Arts, at the University of Minnesota, would normally finish their freshman year. The general hypotheses were that: 1). Students of high potentiality for college work are more satisfied with the educational aspects of college than are the students of lesser potentiality, 2). Women are more satisfied with their college experiences than men, 3). Men students of high achievement are more satisfied than those of lower achievement but of the same potentiality, and 4). Women students of high achievement are more satisfied than those of lower achievement but of the same potentiality.

Samples

Two samples were selected: 1). High potentiality students with a percentile rank of 90 or above on the 1952 college edition of the American Council on Education Psychological Examination, using University of Minnesota freshman norms, and a high school rank of 90 or above, and 2). Average potentiality students with percentiles within one-half standard deviation of the class mean on both indexes. There were 142 students of high and 176 students of average potentiality meeting all criteria.

Method

Portions of the Roy College Satisfaction Index were given, an attached questionnaire, and space for free responses concerning college experiences of value. Scores were tabulated separately for men and women of the two potentiality samples, and means compared with previous studies. The means for men and women of average potentiality differed significantly from means for men and women of Gamelin's norm groups only on satisfaction with faculty advising. The men of high potentiality had significantly higher means than the norm groups on satisfaction with Curriculum, Instructors, Faculty Advising, and College in General and women of high potentiality had significantly higher means on the same scales and with Opportunities for Cultural Development.

The means for the average potentiality men were below the Almos means, and the means for high potentiality men were above. The differences between average potentiality men and the Almos men were significant for five scales while those between the high potentiality men and the Almos men were not significant.

Homogeneity of variance was checked using the L_1 test, and differences between the groups was studied by analysis of variance methods for unequal samples sizes.

Results

When students were classified by Potentiality and Sex, higher means were found for the high potentiality groups and for women. The differences related to potentiality were significant for satisfaction with Curriculum, Instructors, Opportunities for Cultural Development, and College in General, while those related to sex were significant for satisfaction with Curriculum, Social Life, and Opportunities for Cultural Development.

Men and women were then classified by Potentiality and level of College Achievement. The higher mean for lower achieving men on satisfaction with Opportunities for Cultural Development indicated a significant difference associated with potentiality, but interaction raised doubts of any real difference. The higher mean on satisfaction with Curriculum for the higher male achievers indicated a significant difference associated with college achievement. No differences were found for women classified on Potentiality and College Achievement.

The general conclusions were that freshmen students of high potentiality reported themselves as more satisfied than students of average potentiality, women freshmen as more satisfied than men, but that high achieving students of the same potentiality did not indicate more satisfaction than lower achieving students of the same potentiality.

Microfilm $2.65; Xerox $9.20. 203 pages.

CRITERIA FOR ADMISSION TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF TEXAS IN RELATION TO THE APTITUDE TEST OF THE GRADUATE RECORD EXAMINATIONS

(L. C. Card No. Mic 59-6731)

Oliver Hoyt Williams, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Frederick Joseph Adams

The purpose of this study was to evaluate the Aptitude Test of the Graduate Record Examinations as an admission requirement and as an aid in selecting and counseling students of the Graduate School at The University of Texas. Secondary to this purpose was the evaluation of other admission requirements by the statistical analysis of the

data submitted by applicants to the Graduate School in keeping with its regulations. The objective of this statistical analysis was the appraisal of the data as sample assays of scholastic aptitude upon which the prediction of success of the student in graduate study might be based. In the analysis the total and subtest scores, verbal ability, and quantitative ability were used. A tertiary purpose in the study was to demonstrate the use of these scores as a standard for making comparisons of scholastic aptitude in the Graduate School. To accomplish this comparison a Standard Student Group was characterized as the product of the undergraduate divisions of the University. This group of 136 graduating seniors in 1957 was used as the basis for drawing comparisons with other groups.

In making this comparison students were grouped according to major fields of study in the Graduate School. They were, also, grouped according to the college or university which awarded the student his first bachelor's degree.

The sample was drawn from 1,303 applications which were processed during the registration periods: February through September, 1957. Of this number, 486 students, who were working toward a master's degree, completed sufficient semester hours of credit to meet the Success Criterion. In addition to this master's degree group 83 doctoral students met the Success Criterion. However, due to sample size, this group was not fractionated by major and by college awarding the student's first bachelor's degree.

The data were processed to provide arithmetic means and standard deviations of the variables as well as the intercorrelational coefficients between the pairs of variables according to the established groupings. Other statistics used were the significance of the mean differences for the groups, standard errors, critical ratios, multiple correlations, and regression equations computed for the groups of majors. A probability table was prepared based on the total score of the Aptitude Test of the Graduate Record Examinations and the Advanced Average (predictors) and the Graduate Average (criterion) for the group of students who were majoring in fields which were classified as mathematical and mathematical-science. In addition summaries of the computations were provided as forty-six tabulations. Other predictors used with the Standard Student Group were: (1) grade point averages computed on the basis of all work completed at the University, and (2) a Professor's Rating of the graduate student in the first graduate course for which the student registered in his major field. This rating was an appraisal of the student's intellectual potentiality as a graduate student in that major.

The Standard Student Group provided a satisfactory basis for making comparisons of groups in the major fields as well as groups from colleges when those colleges were classified according to the highest level of degree offerings, type of control, to name two of several classes. This demonstration of the use of the Aptitude Test and the Standard Student Group for making comparisons may have application in many institutions where there is a necessity for evaluation of the quality of students.

The correlations between the variables were in keeping with other studies reported in the literature. The multiple correlations derived in the study using the predictors (Advanced Average and total score) with the criterion (Graduate Average) were at the substantial level for the various groups according to majors, except Education and Fine Arts.

Students who received their undergraduate training at The University of Texas and who applied for admission to the Graduate School and who completed sufficient semester hours to meet the Success Criterion tended to be scholastically superior, as measured by the Aptitude Test of the Graduate Record Examinations, to students who received their training in other colleges and universities and transferred to the Graduate School, and met the Success Criterion.

Other conclusions were reported as well as a list of suggestions for further study.

Microfilm $3.30; Xerox $11.20. 253 pages.

AN INVESTIGATION OF THE NATURE OF COMPREHENSION GAINED THROUGH READING AND ITS RELATIONSHIP TO OTHER ASPECTS OF READING AND TO ACADEMIC ACHIEVEMENT

(L. C. Card No. Mic 59-6661)

James Clyde Wright, Ph.D.
The Ohio State University, 1954

INTRODUCTION AND STATEMENT OF THE PROBLEM

Reading is a very important process which has a profound bearing upon many activities in life. The importance of reading is particularly evident in higher education where success or failure may depend upon a student's ability or inability to read vast quantities of text.

Accurate evaluation of the college student's reading capacity is important in counseling students, in helping them to select courses wisely, and in predicting the possibilities of their success in fields of study at colleges and universities.

In cases where remedial work is indicated for the improvement of reading skill, the adequacy of methods of measuring reading ability is a problem of equal importance.

Among factors generally recognized as important components of reading ability is the capacity to comprehend ideas, concepts, and meanings presented on the printed or written page.

Primarily the present study had to do with the measurement of comprehension gained through reading. The main objective was to find a more accurate way of measuring comprehension gains than has so far been discovered.

The plan was to arrive at this new type of measure through the use of difference scores. The attempt was made to control the effect of previous knowledge upon the reading process. Interest was especially centered upon the effect which previous knowledge has upon the comprehension of materials similar to those found in college textbooks.

HISTORICAL BACKGROUND

A search of the literature in the field of reading measurement at the college level failed to reveal any research or information relating to a difference-score method of measuring reading comprehension. Although some test makers[1] have attempted to control the effect of previous

knowledge through the use of unfamiliar and strange materials in the reading passages, the methods have not provided a statistical evaluation of the effects of previous knowledge upon reading comprehension.

Investigators in the field of the psychology of learning and forgetting have probably made the most direct attempt to control the effect of previous knowledge upon the processes they were measuring, through the use of non-sense syllables. So far as the writer has been able to discover, however, they have failed to relate their findings specifically to the reading process and the measurement of comprehension in reading.

Some aspects of the present research are related to the studies of Spitzer[2] and Sherman[3] and others in that they attempted to determine the relationship of measurements of reading capacity to school achievement and to ratings in intelligence. The effects of testing comprehension after a delay period has elapsed between the reading of the selection and the testing has also been evaluated by these investigators. All of these studies, however, have failed to take into account the factor of previous knowledge and its effect on gains in comprehension. In no case has a difference-score measure of reading comprehension been attempted.

METHOD

The materials selected for use as the reading passage in the present study were comprised of portions of two articles. Part I of the selection was taken from an article entitled "Exploring The Mysteries of Plant Life" by William J. Showalter.[4]

Part II of the selection was taken from the instruction manual for the soil testing kit sold by The Sudbury Laboratories.[5]

The reading materials met the following criteria: They compared favorably to college textbook assignments on the basis of length (4200 words), level of difficulty, vocabulary, and style of writing. They were appropriate for use in a 50-minute college class period. They presented a sufficient number of facts, ideas, and meanings from which test items could be made for three reliable and equivalent tests of comprehension. They had the favorable characteristics of attention-getting and attention-holding.

The three forty-item quizzes were of the multiple-choice, four-choice type. Odd-even reliability coefficients, after correction with the Spearman-Brown formula,[6] were: .68, .72, and .74.

These quizzes and the reading selection were administered to 247 college students comprised of the four college class groups of freshmen, sophomores, juniors, and seniors.

Six sequences of administration were used. Each of the three forms of the comprehension test was administered in some one of three periods related in time to the reading of the passage. The three periods were defined as the pretest—given seventy-two hours before the passage was read; the immediate test—given immediately after the passage was read; and the delayed test—given forty-eight hours after the passage was read.

For two reasons, namely, absence from one of the test sessions and lack of ratings on the standard reading and intelligence tests, the original group shrank to 176. This final group, for which complete data were available, was composed of thirty-four freshmen, sixty sophomores, fifty-five juniors, and twenty-seven seniors. For these subjects the following scores and measurements were available and were tabulated to be used for correlational and other comparative purposes: The error-score and the number of correct responses to the pretest, the immediate test, and the delayed test; the difference scores resulting between the error-scores on the three comprehension tests; the point hour average; the Diagnostic Reading Test scores for reading rate (words per minute), story comprehension, vocabulary, and paragraph and story comprehension; the language and total scores on the American Council on Eduatcion Psychological Examination; and the reading rate (words per minute) on the Plant-Life selection.

RESULTS AND CONCLUSIONS

The data were treated in a manner which would provide answers to eight major questions and several minor ones. The questions and their resulting answers, along with the data used for obtaining the answers, are as follows:

1. Does the mean comprehension score earned before the reading of the passage differ significantly from the mean comprehension score earned immediately after the reading of the passage?
2. Does the mean comprehension score earned before the reading of the passage differ significantly from the mean comprehension score earned forty-eight hours after the reading of the passage?
3. Does the mean comprehension score earned immediately after the reading of the passage differ significantly from the mean comprehension score earned forty-eight hours after the reading of the passage?

The results used in answering the three foregoing questions involve the error-scores as follows:

TABLE I

Test	M Error-Score	Difference	σ of difference	t
Pretest	24.74			
Immediate	17.11	7.63	0.50165	13.24
Pretest	24.74			
Delayed	19.00	5.47	0.4512	12.16
Immediate	17.11			
Delayed	19.00	1.89	0.5400	3.90

The t in each of the differences is significant beyond the .01 per cent level of confidence, and we are assured that the differences are greater than what might have occurred by chance. Thus we conclude that the tests are sensitive to the effects of reading and can be used for making comparisons of the capacities of college students in respect to reading comprehension.

4. Which of the measures of reading comprehension shows the highest relationship to grade point average?

The traditional measure of comprehension, or the immediate test score, showed the highest coefficient of correlation (.43) with the grade point average. The next highest measures in their relationship to the grade point average were the delayed tests (.40) and the preimmediate difference score (.33).

5. What is the relationship of the preimmediate difference score to other commonly used measures for evaluating

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reading ability? The correlation coefficient of the pre-immediate difference score to the following measures of reading ability was found to be:

A. Vocabulary on the Diagnostic Reading Test	.29
B. Word-per-minute rate on the Diagnostic Test	.19
C. Word-per-minute rate on the Plant-Life Test	-.05
D. Story comprehension on the Diagnostic Test	.22
E. Paragraph-story comprehension on the Diagnostic Test	.34

Thus the difference score in this instance has more in common with the combined paragraph and story comprehension score on the Diagnostic Test than with any of the other listed measures. Even this correlation coefficient, though significantly different from a zero correlation, is too low to be of any great value for predicting one score on the basis of the other.

6. How much do the immediate test score and the pre-immediate difference contribute, if anything, to the intelligence test score as a predictor of grade point average?

The correlation coefficient for the ACE total score and the PHA is .53. The multiple correlation coefficient obtained for the three variables of ACE total score, PHA, and immediate test score is .5457. The multiple correlation for the three variables of ACE total score, PHA, and preimmediate difference score is .5407. These two scores resulting from the comprehension tests used in the study thus add nothing of significance to the predictative value of the ACE total score for point hour average.

7. What was the effect of having different classes of items, such as repeat and nonrepeat, factual, paraphrase, and application, included in the three comprehension quizzes?

Since the number of items used in these instances was too small for reliable comparisons, only trends can be noted. These trends show the repeat items having a greater percentage answered correctly than the nonrepeat items, with the difference between the two classes of items increasing on the immediate and the delayed tests in this respect. The differences, however, are not statistically significant.

The responses to the factual and paraphrased items follow a closely parallel pattern so far as mean error scores on the three quizzes are concerned. The tendency is for the ratings to be relatively high for the pretest, to drop to a low for the immediate test, and then to increase slightly on the delayed test.

For the application items there is a downward trend in mean error score from the pretest, to the immediate test, and to the delayed test. The differences, however, can be used only as possible indicators of trends.

8. (A) Is the intercorrelation between the scores on the immediate and the delayed tests greater or less than their respective coefficients of reliability? The results show the correlation coefficient of these two tests to be .68 and .74. It is thus concluded that neither comprehension test has much to add to or detract from the other so far as this type of measurement goes.

(B) The correlation coefficient existing between the immediate-delayed difference score and the grade point average is .0169. This shows that practically no relationship exists between these two scores and that one cannot be predicted from the other.

(C) The correlation coefficient obtained between the immediate-delayed difference score and the ACE total score is .24, indicating a relationship that is significantly different from a zero coefficient (a coefficient of .19 is significant beyond the .01 per cent level of confidence) but is of no particular value so far as predictions from one to the other is concerned.

In general, the results of the study provide a positive answer to the query posed by the statement of the problem, namely, that a difference score can be used as a means of measuring gains in comprehension made through reading. It was also shown that this score has little value that is not already afforded by the more easily obtained immediate test score.

Even though few positive results have been obtained by the study, the negative results give support to the customary and usual method of measuring comprehension gained through reading. They permit us to conclude that perhaps the method of measuring comprehension immediately after the reading of a passage is about the best there is to be devised. Microfilm $2.50; Xerox $8.20. 178 pages.

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3. Sherman, A. W. "An Investigation of Delayed Comprehension and Its Relationship to Other Aspects of Reading and to Academic Success." Doctoral dissertation, The Ohio State University, 1952.

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5. Sudbury Laboratories, South Sudbury, Mass. Paper covered printed manual for the soil testing kit, undated.

6. Garrett, Henry E. Statistics in Psychology and Education. New York: Longmans, Green and Co., 1941, p. 319.

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EDUCATION, TEACHER TRAINING

A STUDY OF PRACTICES IN STUDENT TEACHING IN SELECTED UNIVERSITIES WITH RECOMMENDATIONS FOR THE IMPROVEMENT OF THE FULL-TIME STUDENT TEACHING PROGRAM IN MUSIC AT THE OHIO STATE UNIVERSITY

(L. C. Card No. Mic 59-6628)

Stephen Milburn Clarke, Ph.D.
The Ohio State University, 1954

This study was initiated because of the inauguration of the full-time student teaching program in music at The

Ohio State University, because of the lack of information about full-time student teaching in music, and because the music student teaching program has never been formally evaluated since its inception as the Department of Music in 1926.

Three basic premises are used for basic guidance in the study: (1) the principles of student teaching set forth by American Association of Teachers Colleges are acceptable guide lines for the improvement of a full-time student teaching program; (2) practices derived from these principles and checked with practitioners in the field of student teaching can be used to improve activities in the field of student teaching; and (3) opinions and suggestions of all individuals concerned with the student teaching program can be used in determining the strengths and weaknesses of the course.

The study was confined to student teaching in music, with emphasis upon recommendation of practices for the improvement of the student teaching course in the School of Music of The Ohio State University. Data in the investigation were secured from literature in the field of student teaching, a collection of opinions and practices from forty-two publicly supported teacher-training institutions whose departments of music were members of the National Association of Schools of Music, and opinions and suggestions from all the individuals involved in the music student teaching program at The Ohio State University.

The data on student teaching practices in music obtained through a questionnaire were categorized as to percentage of acceptance. Levels used were: acceptance of 75 per cent or above, 60 per cent or above, and the remaining group. The data were presented by principle. All the practices advocated in Principle I, which dealt with relating theory and practice, were accepted by over 75 per cent of the group, and thus were placed in the first category. The practices were: acquiring musicianship, gaining a knowledge of school music literature, obtaining a knowledge of the place of music in the lives of people, and experiencing the use of methods and materials in a school situation. Practices involved in planning the laboratory experience stemmed from Principle II. Those found to be in the first category were that prerequisites to student teaching should be passing a speech test, music examination, hearing test, health examination, teaching personality test, major applied music examination, advisor's rating, minimum point-hour cumulative, and a minimum professional point-hour ratio. Practices in the second category were an interview with a school administrator and taking student teaching as a full-time experience for one term. Those receiving support from less than 60 per cent of the supervisors were an interview with a psychologist, taking student teaching concurrently with methods, spreading student teaching over a period of a year, taking it during the junior year, taking it during the junior and senior year, having students from small high schools do student teaching in large schools, and vice versa.

Those practices dealing with the extent of student teaching experiences which were derived from Principle III were that student teachers should meet slow and fast learners, experience class and organization work on all three levels, and have an opportunity to take more student teaching. All of these practices were supported by over 75 per cent of the supervisors of music student teachers.

Principle IV dealt with the participation of student teachers in typical teacher activities. Activities categorized in the first group were that student teachers should make case studies, give and interpret music tests, and participate in other aspects of the school and community. They also supported the idea of having student teachers manage routine affairs, such as operating ventilation and lighting, cleaning and arranging music storerooms, caring for music supplies, arranging bulletin board displays, using duplicating machines, learning how to make lantern slides, keeping inventory of equipment, checking and reporting daily attendance, and assisting with assemblies, student organizations, and public entertainment. One item, assisting with home rooms, was in the second category. Practices such as making a home visitation, caring for traffic in corridors and assisting with front office routine were in the third category.

Practices advocated in Principle V, developing the professional laboratory experience, which were in the first category were: a student teacher should meet the coöperating teacher before student teaching begins; student teachers should have a share in the planning of the student teaching experience; they should meet the regular staff of the school; they should be given time to adjust to the coöperating school; and they should confer with the administrative head of the school. One item was placed in the second category: student teachers should have a part in selecting their coöperating teachers.

Those activities derived from Principle VI, the integration of student teaching and prior professional work, were placed in the first and second category. Those in the first group were: student teaching should come after methods courses; observation and participation with pupils should take place before student teaching; observation should be part of the music and general methods courses; group and individual observation should come before student teaching; and students should work with pupils as part of their methods course work. Items placed in the second category were: music education students should work in community agencies prior to student teaching; observation should be part of the major subject matter and educational psychology classes; students should work with public school pupils prior to student teaching; and they should work with pupils as part of their major subject matter classes.

Evaluation of student teachers was the main intent of Principle VII. Practices which were well supported consisted of basing evaluation upon participation in group conferences, actual teaching, checklists by campus supervisors, checklists by campus supervisors and student teachers, lesson plans, pupils's work, and the giving of approximate midterm grades to student teachers. In the second category were found the use of case studies, teaching personality tests, and allowing the student teacher to enter into the grading. Most critical practices were the use of logs, diaries, and pupil questionnaires for evaluation purposes.

Activities from Principle VIII which dealt with the physical facilities and community experiences in a full-time, off-campus student teaching program were: off-campus student teachers should attend and assist with community and professional activities; they should attend Parent Teacher Association meetings; and student teachers should meet parents on a social basis. Making a survey of community musical resources was placed in the second category.

Practices which were well supported in Principle IX,

the relationship of pre-service and in-service education, were: student teachers should learn that music education is a constantly changing subject; students should read current professional literature; they should join the Music Educators National Conference; they should evaluate their own teaching; and colleges and universities should maintain follow-up programs for their graduates. Two practices which were placed in the second group were that student teachers should use verbal evaluation periods and original tests with pupils. Practices in the third category were that student teaching should be done away from the campus, and that student teachers should use pupil questionnaires and standardized tests as part of their student teaching experience.

Data were also obtained from a questionnaire structured from the same principle regarding the practices used in the music student teaching programs. Those questions, which were derived from Principle I, dealing with the allowance for coöperative planning and discussion of objectives in the student teaching program, seemed to be met satisfactorily. Help also was given to student teachers in score reading, use of library materials, obtaining resource people, and examining music materials by a large majority of the schools.

Information on planning the laboratory experience, Principle II, showed that most of the institutions scheduled their student teaching course in the senior year. The largest number used the one-period-a-day plan for daily length of the student teaching course, but a surprisingly large number used the one-half day or full-day experience. Most common prerequisites for student teaching, which were in use in more than 40 per cent of the schools, were a rank of senior and a minimum major, professional, and total cumulative point-hour ratio.

In determining the contacts campus supervisors had with student teachers prior to student teaching, the writer found that most of them had contacts through methods courses. A majority were advisors, while a fewer number met their students through subject-matter classes and applied music work.

Results from the questions structured from Principle III, which dealt with the extent of student teaching experiences, indicated that 53 per cent of the institutions offered additional hours in student teaching beyond the minimum requirement for graduation of certification. Eighty-eight per cent of the respondents indicated that their students came into contact with pupils from differing economic strata, while all reported their students met slow and fast learners. Over 50 per cent of the supervisors indicated that their student teachers met music classes and ensembles of all three school levels.

Data obtained from questions derived from Principle IV indicated that 62 per cent of the institutions required their music education majors to do student teaching in both the vocal and instrumental areas. Eighty-five per cent noted that student teaching was required in the student's teaching minor. An average of 6.7 hours per week were spent in actual teaching, and an average of 5.8 hours per week in observation and assisting in other parts of the school. Audio-visual teaching aids used by music student teachers in a majority of the institutions were films, duplicating machines, and bulletin boards.

Practices in the selected institutions in planning the student teaching course were derived from Principle V. Those which had been in use in 50 per cent or more of the schools were: having an informal meeting of the student and coöperating teacher before the teaching assignment begins, having the student teacher meet all the staff of the school, and providing time for him to become familiar with the daily schedule and the philosophy of the school.

Principle VI dealt with the integration of student teaching and prior professional work. Most of the supervisors favored placing music and general methods before student teaching. Very few scheduled general and music methods concurrently with student teaching. Most of the individual and group observation was done in the junior year. The greatest percentage of work with children occurred in the junior year. The greatest amount of observation and participation in class work was in the music methods classes. Community agencies which had been used were brownies, boy scouts, girl scouts, and churches.

Questions on evaluation of the student teacher were derived from Principle VII. Student teachers were visited an average of 7.4 times during the student teaching experience. Over one-half of the institutions have both a coöperating teacher and a campus supervisor responsible for student teachers. In most cases written suggestions for the orientation of student teachers were given by the college to the student and coöperating teacher. Items which had been used as a basis for evaluation by over half of the institutions were: participation in group and private conferences, observation of actual teaching, logs and diaries, lesson plans, and midterm grades. In 12 per cent of the institutions the student teacher had a voice in his own evaluation. In most of the schools it was done by the campus supervisor, the campus supervisor with the coöperating teacher, or the coöperating teacher alone.

Principle VIII was concerned with the administrative and physical facilities in the student teaching program. The types of coöperating schools used mostly by the selected institutions were public schools and a combination of campus and public schools. Of the selected institutions, 47 per cent indicated that some of their student teaching was done away from the community in which the campus was found. It was noted that in over 50 per cent of the institutions which carried on a form of full-time student teaching, over 50 per cent of their student teaching was done off-campus. Expenses incurred to the student teacher were usually borne by the student teacher. Over 50 per cent of the respondents indicated that attending professional meetings and assisting with community music activities were experienced by their student teachers. The coöperating teacher's teaching load was adjusted in 31 per cent of the schools, while campus supervisors had an average maximum load of 17.3 student teachers and an average minimum load of 10.3 student teachers. Coöperating teachers maintained a maximum average of 3.2 student teachers and a minimum average of 2 student teachers.

Questions asked on Principle IX were concerned with how teacher training institutions have bridged the gap between pre-service and in-service education. Ninety per cent of the institutions had a campus chapter of one of the national professional music education organizations. Thirty-one per cent of the institutions provided a follow-up course to student teaching for this purpose, while follow-up programs for graduates were maintained by 28 per cent of the institutions. Group conferences were used by all the institutions in varying degrees. Practices most used by the selected schools were: discussion of student problems,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

discussion of current professional articles, review of methods courses, and invited guest speakers.

Interviews with representatives of eleven of the institutions made it apparent that a definite trend toward a full-time experience in student teaching existed. Six main problems seemed to be facing those in charge of student teaching programs in music in these institutions. The first and most common problem was the diversity of purpose which existed in music departments preparing both music teachers and professional players. The orientation of the coöperating teacher to the student teaching program was the second problem discovered through interviews. The third most pressing problem involved the freeing of student teachers from campus obligations during student teaching. Supervisors who were interviewed were found also to be concerned about student teachers's lack of concern for the total school situation. Problems five and six dealt respectively with the pre-student teaching experience of music majors and the scheduling of transfer students for full-time student teaching.

The Actual Evaluation of the Music Student Teaching Program at The Ohio State University Administrated over a Three-year Period, 1951 to 1954

The following eight problems were discerned.

1. How can student teachers be aided in developing the use and understanding of such skills as group planning, use of motivation, selection of materials, classroom control, and unit planning?
2. How can student teachers in music be aided in gaining more experience in guiding pupil activities?
3. How can music student teachers be aided in gaining musical and professional growth?
4. How can coöperating teachers and the University supervisors be helped to do more effective work with student teachers?
5. How can the combined vocal and instrumental weekly group conference be improved?
6. How can the Student Teaching Manual be improved so that more value will accrue to the student teachers from its use?
7. How can student teachers be aided in seeing more value in the observation done during student teaching?
8. How can some of the minor administrative details be solved in the field experience program?

Twenty recommendations made were:

1. The coöperating teachers should be brought in for a planning and evaluation workshop which is to be initiated by the Director of Field Experience.
2. The pamphlet developed as part of the dissertation should be distributed to coöperating and student teachers to inform them of the objectives of the student teaching program in music and to suggest ways in which these objectives might be brought about. This pamphlet should be revised as the need for it arises.
3. The present combined instrumental and vocal group conference should follow the general plan of discussing current professional literature, using guest speakers, and utilizing those conferences which student teachers have indicated as being most helpful.
4. Area conferences should be held daily or every other day during the first two weeks of the quarter. These conferences should be devoted to the predicated needs of student teachers reported in this dissertation.
5. The Student Teaching Manual should be used to summarize and evaluate the three areas of experience carried on in the student teaching course. In the Manual approximately fifty per cent of the space should be given to the major music area, twenty-five per cent to the minor music area, and twenty-five per cent to activities in other parts of the school. A weekly individual conference should be devoted to consideration of the Manual by the University supervisor and the student teacher.
6. The Student Teaching Manual and one or two of the special area conferences held at the beginning of the quarter should be used to improve the observation of teaching by student teachers.
7. Exploration should be made for methods for more observation and participation in the pre-student teaching experience of music education majors at The Ohio State University.
8. The conferences and supervision always should be directed toward helping student teachers gain musicianship, knowledge of music, and ability to teach.
9. Student teaching assignments should be made during the quarter previous to the quarter student teaching is done.
10. The Director of Field Experience should investigate the possibility of maintaining a coördinator of field experience for the three teacher-training institutions and the Columbus City School District.
11. The coöperating teacher's load should be adjusted when assigned a student teacher.
12. The campus supervisors of student teaching should be given twice the time they are now given to direct each student teacher.
13. The student teachers should continue to be brought into the planning and evaluation of the student teaching experience.
14. A half-day experience for two quarters should be considered for weaker student teachers in music.
15. An attempt should be made to place full-time vocal student teachers in a coöperating school in which they are responsible to only one coöperating teacher for grades one through twelve.
16. Exploration should be made of the feasibility of using cooperating schools which are away from the community in which the University is found.
17. The last two weeks of the special vocal and instrumental conferences should be devoted to evaluating the student teaching experiences, both individually and as a group.
18. Exploration should be made in the use of personality tests as a prerequisite and an evaluation instrument of the student teaching experience.
19. Assignments should be made which will include both class and organizational work on the elementary junior and senior high school levels.
20. The evaluation of the student teaching program in music should be continued with the instruments developed in the dissertation.

Microfilm $4.90; Xerox $16.80. 394 pages.

Abstract published by special arrangement with The Ohio State University.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

CHILDREN'S ART EXPERIENCES INTERRELATED WITH OTHER SCHOOL EXPERIENCES—A PHILOSOPHICAL STUDY WITH IMPLICATIONS FOR THE PROGRAM OF ELEMENTARY EDUCATION, THE UNIVERSITY OF GEORGIA.

(L. C. Card No. Mic 59-5680)

Sue Woodruff Cromartie, Ed.D.
University of Georgia, 1959

Supervisor: Dr. Rachel S. Sutton

The purposes of the study are (1) to formulate a philosophy concerning children's art expressions related to their growth and development and interrelated with other school experiences, (2) to evaluate the undergraduate elementary education program at the University of Georgia in terms of preparing teachers to interrelate children's art experiences with other school experiences, and (3) to make definite proposals for improvement in the program as the data imply that improvement is needed.

The philosophical method of research was used in the first part of the study. A philosophy developed from (1) a review of literature in the fields of child development and education, and (2) field observations of children in natural settings.

The descriptive method of research was used to examine the elementary education program at the University of Georgia. Certain required courses were analyzed for the contributions of each toward the preparation of teachers (1) for understanding creative development as a part of total development, and (2) for interrelating children's art experiences with other school experiences. This analysis consisted of an examination of (1) catalogue descriptions, (2) course syllabi, instructor's guides or outlines, (3) student handbooks or workbooks, (4) required textbooks, (5) required readings, (6) other required experiences such as students' resource units and teaching logs, (7) observations made through auditing The Visual Arts and through working as teaching assistant in Curriculum and Procedures, and (8) conferences with chairmen of course programs.

The courses were studied a second time, collectively, for their composite contributions toward this segment of teacher preparation. The second inquiry utilized as evaluative criteria the implications for teacher education drawn from the philosophy developed in the present investigation.

The evaluation of the courses by the two methods revealed that certain weaknesses exist in the elementary education program at the University of Georgia in the area studied. Recommendations for program changes have been made.

Through this process of investigation the following conclusions have been reached:

1. The ability of children to express through the visual arts is natural and universal. There are fundamental tenets for guiding the development of this ability. Although the investigation was made in one institution, its philosophy is applicable to any teacher training institution.

2. Interrelating art experiences with other school experiences is valuable to the child, to his art, and to other areas of his learning. Although the study was limited to the visual arts, its findings are applicable to the other creative arts--creative writing, dramatics, music, or dance.

3. The preparation of elementary school teachers for interrelating children's experiences is most successfully achieved if the teachers participate in interrelated experiences during their pre-service education. Although the investigation was limited to the interrelation of The Visual Arts with other required professional courses, the findings are applicable to any area of teacher education.

4. The philosophical and descriptive methods of research are suited to studies of a rudimentary nature. The present study is suggestive of needs for further research and experimentation in teacher education by the institution where this initial study was made and by state in-service programs. Microfilm $3.95; Xerox $13.20. 305 pages.

COURSES IN STUDENT TEACHING SUPERVISION

(L. C. Card No. Mic 59-5491)

Edward Bernard Flynn, Jr. Ed.D.
The University of Oklahoma, 1959

Major Professor: Claude Kelley

The purpose of the study was to determine the status of basic courses in the supervision of student teaching and to formulate recommendations for such courses in terms of desired outcomes, structure and administration, content, and methods of teaching.

The population used for the study consisted of 267 institutions holding membership in the American Association of Colleges for Teacher Education and offering graduate programs. A preliminary survey revealed that 97 of these institutions offered courses in the supervision of student teaching. Seventy-five of these institutions completed the instrument which was mailed to them, and sixty of these were found to be usable for the purposes of this study.

Conclusions to be drawn from the study may be summarized as follows:

1. Basic courses in the supervision of student teaching contribute to the accomplishment of the following outcomes: a better understanding of their functions on the part of supervisory personnel, increased effectiveness on the part of supervising teachers in working with student teachers, a better understanding of the total teacher education program on the part of supervisory personnel, and increased cooperation between colleges and public schools in the preparation of teachers.

2. States which require certification for supervisors of student teachers should include in the requirements a graduate level course in the supervision of student teaching. If no certificate is required for supervisors of student teachers, the course should be tuition-free for all participating personnel.

3. The content of the basic course in the supervision of student teaching should include (a) the philosophy, administration, and structure of the institution's teacher education program (b) an explanation of the responsibilities of personnel involved in the student teaching program (c) an explanation of the major functions of the supervising teacher, including orientation, guidance, and evaluation of student teachers and (d) topics relating to effective instructional techniques and ways of working with children.

4. Instructional methods recommended for the basic

course in the supervision of student teaching include (a) group processes including panel discussions, sociodrama, and the use of resource persons (b) individual projects and (c) the development of instructional materials.

5. Effective methods of evaluating the course in terms of desired outcomes include (a) verbal and written evaluation by the participants at the end of the course (b) comprehensive follow-up studies of participants a few months, a year, and several years following completion of the course and (c) information gathered from college supervisors. Microfilm $2.50; Xerox $5.60. 113 pages.

A SURVEY OF PROCEDURES FOR EVALUATING STUDENT PROGRESS IN PROFESSIONAL-EDUCATION COURSES OFFERED BY THE TEACHER-PREPARING INSTITUTIONS OF OHIO

(L. C. Card No. Mic 59-5386)

Robert Elbert Hubbard, Ph.D.
The Ohio State University, 1953

In recent years American educators have placed increased emphasis on the need for more-comprehensive goals for all levels of education. The incorporation of these goals into educational programs has accentuated the problem of ascertaining student progress or growth since many of the new objectives, for example, personal-social relationships, attitudes, beliefs, and physical growth, are relatively intangible.

The dissertation grew out of this general problem of evaluating student progress in relation to the new goals of education. Specifically, the primary purposes of the study are: (1) to describe comprehensively present practices and judgments of teachers of professional-education courses in the teacher-preparing institutions of Ohio concerning the evaluation of student growth, and (2) to analyze these practices on the basis of principles of evaluation formulated by the writer in coöperation with two other doctoral students at the Ohio State University.

The State Department of Education of Ohio has approved colleges and universities in the State for the preparation of teachers. Bulletins issued by these institutions listed a total of 333 persons whose instructional rank carried the designation "education." An eight-page questionnaire was mailed to each of these staff members, and 212 usable questionnaires, representing 63.6 per cent of the total number sent, were returned.

Data collected from this population of college teachers include: (1) information concerning the nature and scope of the objectives established in courses taught by the selected group of teachers, (2) the techniques and methods used in evaluating student attainment of these objectives, (3) the types of marking, recording, and reporting practices employed by teachers and institutions for reporting student progress, and (4) judgments of the teachers concerning the values of various aspects of the evaluation process. Analyses of these data were made both for the total group of respondents and for certain subgroups of the respondents classified according to certain characteristics (i. e., type of institution in which the respondent was teaching, sex, instructional rank, number of years of college teaching experience, and average class size).

A comprehensive list of principles of evaluation was developed by the writer in coöperation with two other doctoral students for the purpose of appraising the evaluation procedures of the teachers in the selected Ohio colleges. Basic to the development of these principles was a thorough study of the literature on evaluation. It was believed that additional support regarding the validity of these principles should be obtained by presenting them for examination and appraisal to several noted authorities in the field of evaluation. A thorough review of the literature was undertaken to determine persons noted in this area, and a list of 27 authorities was compiled. A total of 21 of these authorities coöperated in the study by returning their responses to the developed list of principles.

It is important to point out the close relationship of this study to two other doctoral studies conducted at the Ohio State University, each evolving from the general problem of evaluation discussed above. All three studies have as a central theme the current evaluation activities of classroom teachers in selected institutions of Ohio, differing only in the level of education considered. The other two studies deal respectively with evaluation in elementary education and evaluation in secondary education, whereas in this study consideration is focused on the area of teacher education. The three persons conducting these separate but related studies coöperated in many stages of the development of the studies. All three studies have been under the direction of the same faculty adviser.

The following major conclusions are given as findings supported by the data of this study:

1. In addition to the fact that the principles of evaluation accepted in this study are supported by the writings of many well-known persons in the field of evaluation, the reactions of a selected group of the best-known authorities to the specific list of principles are highly favorable.
2. The practice of establishing educational objectives and attempting to conduct evaluation with reference to these objectives was reported by nearly all respondents. These objectives are usually established in written form in terms of broad student goals to be attained or specific student behavior to be sought. The rather infrequent reëxamination of objectives by many of these instructors is suggestive of a degree of failure on their part to adapt objectives to the needs, abilities, interests, and purposes of students.
3. Limited participation by students and other personnel in establishing objectives is indicative of failure to promote coöperation in this important phase of evaluation. However, nearly all the teachers attempt to keep students informed concerning course objectives through discussions with their students.
4. The judgments of the respondents regarding their ability to evaluate the growth or progress of students in relation to the established objectives indicate they feel some lack of confidence or security in their evaluative practices.
5. Numerous and varied aspects of student growth and development were considered to be within

the scope of courses by the great majority of the respondents, although the adequacy of evaluation of certain aspects, such as personal and social development, was considerably less than the adequacy of evaluation of such aspects as ability to think clearly, subject-matter achievement, and potential teaching ability.

6. The techniques and methods of evaluation used by a majority of the college teachers are extremely varied, although the frequency of use is high for a somewhat restricted number of techniques and methods. Conferences with students and class discussions are more "versatile" techniques than tests and examinations in their wider applicability to various aspects of student growth and development. Value judgments of respondents are generally highest for the techniques and methods of evaluation which are used by most instructors and which are used most frequently.

7. Testing practices of the respondents are directed primarily at determining subject-matter achievement of students. Only limited use is made of "pre-tests" and standardized tests of various types in their classes.

8. Student participation in deciding upon those aspects of the course work on which they will be tested or evaluated and in constructing tests or in planning other means of evaluating their progress is limited according to most of the respondents.

9. Nearly all of these Ohio college teachers attempt to keep students informed of their progress by returning tests they have taken or papers they have written, and a high percentage of the respondents stated that they usually discuss the results obtained by use of these devices with their classes and with individual members of their classes.

10. Planning for evaluation and planning future teaching-learning activities on the basis of the results of evaluation tend to be somewhat incidental and may be characterized chiefly as short-term attempts.

11. The assignment of marks is based on a complex of factors, suggesting that marks are interpreted in widely different ways by different teachers.

12. Extremely limited participation by these college teachers in selecting grading systems or in selecting other types of reporting practices was indicated by the respondents. Furthermore, there is general dissatisfaction on the part of both teachers and students with grading systems and other means of reporting student progress.

13. Various aspects of student progress are appraised in written reports or similar devices by approximately one-half of the respondents who use such devices. However, many of this group, in addition to many of the other respondents, also keep information about these and other aspects for their own records only.

14. Fairly extensive information is recorded in cumulative records, but the judgments of the respondents regarding the value of such information are largely directed toward certain types of academic information. Personal information of various types is valued less than are certain types of test information concerning intelligence and achievement.

15. Student evaluation of courses or instruction is used extensively and is judged valuable by most of the teachers who use this approach.

16. Self-evaluation by students is encouraged only incidentally by most of the teachers. Techniques for promoting this ability vary widely. A small number of staff members apparently give no thought to developing this ability and few others indicated that they are unable to develop it.

On the basis of the data of this study, the following recommendations are presented.

1. More concerted efforts should be made in the colleges and universities to involve student participation and coöperation in the various phases of evaluation and to involve other persons wherever appropriate in the procedures of evaluation.

2. Intensive studies should be made of the adequacy of current methods used in the colleges and universities of reporting and recording student progress.

3. Studies should be undertaken to examine carefully the reasons cited by a large proportion of the respondents as preventing satisfactory evaluation of student progress.

4. Provision should be made in the Ohio colleges and universities included in this study for more-extensive use of a variety of evaluative techniques and methods for different evaluative purposes.

5. Greater use of the various sources from which information regarding the growth or progress of students can be obtained should be made by the staff members of the colleges and universities included in this study.

6. Research should be undertaken to develop new techniques and to improve existing ones in order to provide in the colleges and universities for more adequate evaluation of the less tangible aspects of student growth and development.

7. Research should be undertaken to develop techniques and to suggest ways for premoting the ability of college students to evaluate their own progress.

Microfilm $4.00; Xerox $13.40. 309 pages.

Abstract published by special arrangement with The Ohio State University.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

A STUDY OF THE SCIENCE METHODS COURSE FOR SECONDARY SCHOOL SCIENCE TEACHERS

(L. C. Card No. Mic 59-5259)

Eugene Robert Keffer, Ed.D.
Washington University, 1959

Chairman: Raymond E. Callahan

This study is an investigation of the nature of the science methods course for secondary school teaching as it was taught in schools of the North Central Association of Colleges and Secondary Schools in 1957. Further, it is a critique of the course by secondary school science teachers.

The primary purpose of the study was:

1. To determine the topics that experts believed could be taught most productively in a science methods course.
2. To determine the relative emphasis which should be given to each selected topic, as judged by
   a) instructors of the course, and
   b) secondary school science teachers
3. To determine an estimate of the degree of consistency among each group of judges concerning the relative importance of the various topics for inclusion in the course.
4. To determine an estimate of the extent of the agreement among various groups of judges concerning the relative importance of the topics.

A secondary purpose of the study was:

1. To determine if a pre-selected group of colleges and universities offered a science methods course, and, if offered, to ascertain the general nature of the course.
2. To determine the backgrounds of instructors, in these schools, of the science methods course.

Two questionnaires were constructed as data-gathering instruments. One was designed to secure information from the instructors of the science methods course; another was designed to obtain information from secondary school science teachers. The topics included in the questionnaire were organized under the following headings:

1. Objectives
2. Organizing secondary school science
3. Techniques of instruction
4. Materials of instruction
5. Evaluation of instruction
6. Miscellaneous

The data were obtained from instructors of the science methods course in a random sample of colleges and universities, members of the North Central Association of Colleges and Secondary Schools and secondary school science teachers.

The questionnaires were mailed in an initial distribution packet to the administrative head of each participating institution. A follow-up letter was mailed to each known instructor whose questionnaire was not returned in a reasonable length of time. Later, a follow-up postal card was mailed to the administrative head of each institution from which no reply of any kind was received. Finally a duplicate packet was mailed to each non-cooperating teacher.

The following statistics were used in analyzing the data: (1) mean rating, (2) rank order, (3) average rater-to rater correlation, and (5) rank-difference correlation.

The combined judgments obtained showed that the judges disagreed among themselves concerning the importance rankings of specified topics for training secondary school science teachers in terms of the objectives of secondary school science. These combined judgments were unstable, so different importance rankings may have been obtained from a similar group of judges.

The combined judgments obtained showed that the judges agreed among themselves, with a fair degree of consistency, concerning the importance rankings of specified objectives for a science methods course, and specified topics for training secondary school science teachers in terms of organizing secondary school science, and techniques of instruction. These combined judgments showed a relatively high degree of internal consistency, so it could be expected that approximately the same importance rankings would be obtained from a similar group of judges.

The combined judgments obtained showed that the judges agreed among themselves, with a fair degree of consistency, concerning the importance rankings of some specified topics, and a negligible degree of consistency concerning the importance rankings of other specified topics for training secondary school science teachers in terms of the materials of instruction for secondary school science and evaluating secondary school science. The combined judgments showed a relatively high degree of internal consistency, so it could be expected that approximately the same importance rankings would be obtained from a similar group of judges.

Microfilm $3.45; Xerox $11.80. 268 pages.

THE INFLUENCE OF TWO FIELD LABORATORY COURSES ON TEACHER COMPETENCE IN A SELECTED ALABAMA COUNTY

(L. C. Card No. Mic 59-5274)

John Stokes Martin, Ed.D.
Alabama Polytechnic Institute, 1959

Supervisor: Truman M. Pierce

In 1957, the School of Education at The Alabama Polytechnic Institute, Auburn, began a systematic program for improving instruction in the public schools of Alabama. This program included experimental courses in professional education for teachers and administrators in service. The courses were designed to be adapted to professional needs of teachers who enrolled for them and were directed toward imporving their teaching performance. Instruction was based essentially on the teachers' needs and problems and took place in the environment in which

the teachers worked. In this sense the schools and classrooms in which the teachers taught became laboratories for their professional development. The courses were called field laboratory courses and raised the following question toward which this investigation was directed: Do teachers in selected field laboratory courses improve their teaching practices and perceptions of good teaching as a result of the field laboratory courses?

PURPOSE OF THE STUDY

The purpose of this study was to evaluate two selected field laboratory courses in terms of changes in certain perceptions and practices of the teachers who participated in them.

HYPOTHESIS

At the beginning of the study the investigator predicted that teachers who participated in selected field laboratory courses would improve their perceptions and practices of teaching more than would those teachers in the same schools who did not participate in the field laboratory courses.

METHODS AND PROCEDURES

During the course of the study, it was necessary for the investigator:

1. To select an experimental and a control group of teachers. Teachers participating in two field laboratory courses in a selected Alabama county composed the experimental group. The remaining white teachers in that county composed the control group.
2. To identify practices and perceptions of teachers to be analyzed and to develop in terms of concepts of desirable changes in teachers' criteria necessary for making judgments of the effectiveness of the two Field Laboratory Courses.
3. To describe the setting of the study.
4. To describe the field laboratory courses being evaluated.
5. To collect data concerning the perceptions and practices of teachers in the experimental and the control groups at the beginning and at the end of the Field Laboratory Courses.
6. To analyze and interpret collected data in light of the evaluative criteria and other factors revelant to changes in the teachers.
7. To state, as outcomes of the study, conclusions concerning changes in the teachers and recommendations for needed research.

Changes in teachers' acceptance of self, teacher role concept, interaction with fellow teachers, and methods of solving teaching problems were measured respectively by the Index of Adjustment and Values, Teacher Role Concept Q-Sort, a device for measuring interaction, and personal interviews and observations.

MAJOR CONCLUSIONS

1. There was insufficient reason to believe from statistical analysis of the data evaluated that the hypothesis was tenable.
2. Statistical analysis of data evaluated left no reason to believe teachers made significant changes in acceptance of self, concept of teaching role, and interaction with fellow teachers as a result of the two Field Laboratory Courses.
3. Teachers participating in the Field Laboratory Courses improved this method of solving teaching problems.
4. Teachers gained better understandings of their fellow teachers and administrators and increased their professional knowledge in terms of their own purposes by participating in the Field Laboratory Courses.

Microfilm $3.10; Xerox $10.60. 237 pages.

TEXTBOOK SUITABILITY FOR THE INDUSTRIAL ARTS PROGRAM IN TEXAS

(L. C. Card No. Mic 59-5961)

Jerry Clay McCain, Ed.D.
North Texas State College, 1959

The problem of this study was to determine the degree of suitability of the current state-adopted textbooks for instructional purposes in meeting the subject matter content of a sound industrial arts program in the public secondary schools in Texas.

The following procedures were utilized:

1. The state-adopted textbooks were classified according to subject matter areas as described by the Texas Education Agency.
2. The objectives of the industrial arts program utilized in this study were those listed by the American Vocational Association and the Texas Education Agency.
3. The subject matter content for the various subject areas was determined by the aid of a jury.
4. Evaluative criteria were developed for use in determining the degree of suitability of the state-adopted textbooks.
5. The degree of suitability of the various state-adopted textbooks was determined through the application of the criteria to the content of the textbooks under study. Data were used as determinants in testing the hypothesis.

The following conclusions are offered and based upon the information and data presented in this study:

1. Textbooks for the areas of drawing and woodworking were found to be more suitable for instructional purposes in a sound industrial arts program than the textbooks for the other subject areas.
2. The state-adopted textbooks for the industrial arts program have a low degree of suitability with respect to much of the approved subject matter content as determined in this study.
3. The textbook for the area of crafts received a low rating, partly due to the absence of treatment of certain phases of the subject area.
4. To conduct a sound industrial arts program, teachers of industrial arts for the various subject areas must rely on supplementary texts and other materials in classroom instruction because of the low levels of suitability of the state-adopted textbooks.
5. There is a need for more comprehensive textbooks in all the subject matter areas, particularly in the subjects of crafts, metalworking, auto mechanics and electricity and electronics.

6. The hypothesis of the study was substantiated, in that textbooks in all areas were found to have a relatively low degree of suitability.

Based on the findings of this study, the following recommendations are made:

1. Consideration be given to other books designed for instructional purposes in industrial arts which might be submitted for study by the textbook committee members and advisors.
2. The teachers of industrial arts subjects be considered in appraising prospective textbooks for the various areas in respect to future adoptions.
3. The study of state-adopted textbooks for the future be continued periodically, and as objectively as possible.
4. Further study be given to state-adopted textbooks for the industrial arts program with respect to other factors which were not considered in this study.
5. Certain of the present state-adopted textbooks be replaced as soon as possible, if more suitable books are available for use in a sound industrial arts program as determined in this study.
6. In evaluating textbooks for adoption for use in industrial arts, close attention be given to the subject matter content of a sound industrial arts program.

Microfilm $2.50; Xerox $5.60. 112 pages.

A STUDY OF CERTAIN PHASES OF THE HEALTH EDUCATION PROGRAM OF THE PUBLIC SECONDARY SCHOOLS OF THE STATE OF WASHINGTON

(L. C. Card No. Mic 59-5468)

Caswell Albert Mills, Ph.D.
University of Washington, 1959

Supervisor: John E. Corbally, Ph.D.

The purpose for this study was threefold: (1) to determine the subject matter being included in the health education programs of the public secondary schools of the state of Washington; (2) to investigate the preparation of health teachers in the fields of science, social science, and health education subjects; (3) to determine the extent of the training program in health education offered by colleges and universities in Washington.

The survey included the responses of 191 teachers from eighty-three secondary schools. The schools were grouped as Urban, Intermediate-Urban, and Rural. All fifteen of the teacher education institutions in Washington were included.

Health education was included in the curriculum as a unit or units of study in biology, general science, home economics, physical education, and as a separate course. Health education combined with another course was the most frequently indicated method of presenting health information. Health and physical education were a common combination. A separate health course was indicated in 36.6 per cent of the responses.

The time spent on health education units was usually in excess of six weeks. The majority of the health classes met five days per week.

The methods used to select course content materials varied considerably. The majority of the Urban schools used some form of committee to determine the health education subject-matter. In the Intermediate-Urban and Rural schools, the individual teacher was frequently responsible for determining course content materials.

Health topics relating to individual care received the greatest emphasis. Subject-matter areas concerning group living and health, or material not directly concerned with the physical well-being of the individual, were less frequently stressed in health education classes.

Health topics which were included in the junior high school course were frequently considered important at the senior high level.

Teachers of health education usually taught courses in addition to health education. The percentage of teachers who taught physical education in addition to health was over three times as great as for any other subject field. Teachers who taught only health education were located mainly in the Urban schools. There were no teachers who devoted full-time to health education in Rural schools.

The most common major for all health education teachers was physical education. A first or second minor in health education was not unusual.

There were thirty-one health teachers who had completed the requirements for a Master's degree. The majority of these were located in Urban schools. The most frequently indicated major for the Master's degree was education. This was followed by physical education.

A large majority of the health teachers had college work in the biological and social sciences. About 50 per cent had preparation in either physics or chemistry. The two courses most frequently reported in the special health subject area were child growth and development and first aid. Less than one-third of the teachers indicated college course work in the health education area. A course in methods and materials for health education had the highest percentage with 32.6 per cent.

Approximately 55 per cent of the respondents indicated a general health education course which had been required by their college or university for candidates for a teaching certificate.

A combination major or minor in health and physical education was the most common method of providing teacher preparation for health education.

Preparation in the biological, physical, and social sciences as well as many of the special health subject areas was available at all of the colleges and universities. Courses in the health education area such as community resources, school health services, and environmental sanitation were frequently combined in a broad health course. Microfilm $2.65; Xerox $9.20. 204 pages.

ANALYSIS OF NON-FARMING AGRICULTURAL OCCUPATIONS FOR BOYS HAVING TRAINING IN VOCATIONAL AGRICULTURE FROM SELECTED COUNTIES IN INDIANA

(L. C. Card No. Mic 59-5628)

Ralph Ray Royster, Ed.D.
University of Missouri, 1959

Supervisor: G. F. Ekstrom

PURPOSE: The major purpose of this study was to determine the basic agricultural skills and training needed by students enrolled in vocational agriculture who later enter non-farming agricultural occupations. A secondary purpose was to determine whether training in vocational agriculture was sufficient in scope and content to prepare former students adequetely for non-farming agricultural occupations.

METHOD OF RESEARCH:

1. Records were obtained for 1,635 graduates of vocational agriculture from twenty-four high schools. These schools are located within Hancock, Henry, Rush and Shelby Counties. The former students graduated during the years 1948-1957 inclusive and had completed one or more years of vocational agriculture.

2. Information concerning the current locations and occupational status of the graduates was obtained through personal interviews in the twenty-four school communities.

3. The occupations were classified according to the Dictionary of Occupational Titles and a job classification listing was made of the 103 persons engaged in non-farming agricultural occupations for which college training is not required.

4. The graduates engaged in non-farming agricultural occupations and their employers were interviewed to obtain information relative to (a) qualifications needed by beginning employees, (b) additional training provided by the companies and (c) suggestions for adjustments in high school training.

SUMMARY: It was found that 31.9 per cent of the 1,635 graduates had completed four years of vocational agriculture; 23.8 per cent had completed three years, 18.4 per cent had completed two years, and 25.9 per cent had completed one year of training.

Of the 1,635 graduates, 14.7 per cent were in the military services, 10.7 per cent were in colleges or trade schools, and 2.6 per cent were deceased or not accounted for. A summation of their known occupations reveals that 27.9 per cent entered farming; 13.3 per cent entered occupations related to farming and 62.9 per cent entered occupations not related to farming. One hundred fifty-three were classified as being employed in occupations related to farming of which 103 or 8.8 per cent were in non-farming agricultural occupations that do not require college training.

The major job opportunities for the graduates in non-farming agricultural occupations were in seventy-five agricultural businesses located within Central Indiana. At the time of the study, these concerns employed 6,692 workers.

Approximately 90 per cent of the employers indicated that graduates of vocational agriculture would need on-the-job training before they could work effectively. Some of this training is concerned with learning about company policy and procedure, although much of it consists of actually learning the work to be done. Employers indicated that schools are not placing enough emphasis on the keeping of records; care, maintenance, and operation of farm machinery; farm management; marketing and economics; how to get along with others in their work and how to meet the public.

CONCLUSIONS:

1. The percentage of graduates from vocational agriculture who enter non-farming agricultural occupations is relatively small as contrasted to those who enter other occupations.

2. Financial requirements limit the number of interested boys who find it possible to enter farming, including those presently working in non-farming agricultural occupations.

3. Generally, it seems that the training in vocational agriculture is inadequate to prepare students completely for non-farming agricultural occupations.

4. It would appear impractical for schools to train students completely for skills in specific non-farming. agricultural occupations.

5. It would appear that systematic follow-up activities with graduates by teachers of vocational agriculture are limited.

6. Employers in non-farming agricultural concerns prefer employees who have been reared on the farm and who have had training in vocational agriculture.

Microfilm $2.50; Xerox $8.20. 176 pages.

AN EVALUATION AND RECOMMENDED DEVELOPMENT OF THE MUSIC EDUCATION PROGRAM AT CAPITAL UNIVERSITY

(L. C. Card No. Mic 59-6650)

Guy Gene Taylor, Ph.D.
The Ohio State University, 1954

The purpose of the dissertation has been to evaluate the program designed to prepare teachers of music at Capital University, to appraise the program's strengths and weaknesses, and to provide data to serve as a basis for revising the music education curriculum of that institution. The evaluative techniques used will provide the university with suggestions for a plan of continuous appraisal to guide future curriculum revisions and may be adapted to other areas of curricula. The report may be of value to other teacher education institutions in checking the effectiveness of their music education programs.

The method of study used to evaluate the program included the following steps:

1. A survey of the literature in the evaluation of teacher education and music teacher education programs

2. Development of functions of the music education program at Capital University and establishment of standards for a good music teacher education program

3. Analysis of the present music education curriculum at Capital University in comparison with curricula of other colleges

4. Construction of questionnaires, and analyses and evaluation of questionnaire returns from recent graduates of the music education curriculum at Capital University,

from public school administrators who have employed Capital University music teachers, from juniors and seniors at Capital University, from co-operating teachers in the music student teaching program, and from music education seniors in two other colleges

5. Interviews with graduates, students, and staff members of Capital University, public school administrators, and co-operating teachers

6. Interpretation of the findings of the study in terms of the degree to which the program seemed to be effective in meeting the specific standards of the music education program

7. Presentation of recommendations for the improvement and further development of the music education program at Capital University

The following basic assumptions, adopted from the literature, were set up for the study:

1. The primary purpose of the music education program is to develop teachers who have the understanding and the insights of well-educated persons, who have competent skill and understanding as musicians, and who have a knowledge and understanding of the techniques necessary to bring meaningful musical experiences to all whom they teach.

2. Evaluation is an important phase of the teacher education program.

3. The process of evaluation should be a co-operative undertaking, for students and teacher, administration and teachers, school and community, and school and graduates.

4. The process of appraisal should be wide in scope and should concern itself with the many phases of growth provided for in the program rather than merely with subject-matter learnings.

5. The important test of any teacher education program is its value in the actual life situations for which the training program was designed.

6. The most direct way to determine the effectiveness of a teacher education curriculum is by questioning individuals who have been educated in the program so as to find out how adequately they were prepared for experiences as teachers and citizens.

7. The evaluation of a music teacher education program should be a continuous process closely integrated with the learning experiences needed by prospective teachers.

8. The results of such a continuous evaluation program should be used to indicate and make needed revisions in the music teacher education program.

The functions of the music education program at Capital University were developed by the writer with the aid of the music faculty, the head of the education department, the dean of the faculty, and president of the institution, and the seniors in music education after a careful search of the pertinent literature and consideration of the stated purposes for Capital University as a liberal arts college. They are as follows:

1. Select students who have the music ability which will indicate a capacity to meet the music requirements to develop good teachers.

2. Select students who have the mental, physical, and personal qualities needed by good teachers of music in the elementary and the secondary schools.

3. Aid each prospective teacher to develop to his optimum ability as a musician—as a performer, a listener, and a theorist.

4. Provide each prospective music teacher those experiences which will help him acquire skills and techniques which, in turn, will help him to bring significant experiences to those with whom he works.

5. Help each student understand the role of music in everyday life, the school, the church, and the community; and the role of the music teacher as he works with pupils, teachers, and parents in school and community to bring music into their lives.

6. Give each student in mucis education the broad, cultural foundation which will aid him in developing into a teacher who is a cultured individual and an intelligent, reflective citizen.

7. Help each prospective music teacher develop Christian character and Christian citizenship.

8. Provide guidance and follow-up services which will aid the graduate in his teaching.

In order to develop a basis for evaluating the program, standards were set up in terms of those competencies which a good music teacher should possess. "The Evaluative Schedule,"[1] developed by the American Association for Colleges of Teacher Education, "The Standards for the Evaluation of the College Curriculum for the Training of The School Music Teacher,"[2] developed jointly by a committee from the Music Educators National Conference and the National Association of Schools of Music, and the "Measures of Teacher Competencies",[3] developed by Group D of the National Commission on Teacher Education and Professional Standards were valuable source materials in this phase of the study.

A good program of music teacher education should provide each student with the opportunity to develop skill and underatanding in (1) the theory of music, (2) the interpretation and performance of music, (3) the creativeness of music, (4) voice work, (5) piano work, (6) work with pupils, staff, and community, and (7) the intelligent solution of problems. The program must help the student acquire an understanding of (1) the history and appreciation of music, (2) the relation of music to other arts, (3) the way children develop, (4) the value of music in everyday life, (5) the organization, management, and objectives of the public schools, and (6) current social problems. The program should help the student (1) to develop musically to the limit of his ability as indicated by tests and auditions, (2) to develop skill in imparting understanding and techniques to others, and (3) to develop mental, physical, and personal qualities essential to a successful music teacher. The program should help the student become competent in planning worthwhile experiences with boys and girls; it must also enable him to acquire a broad cultural background, as well as information and skill in all families of instruments. The program must help the student develop (1) skill and ability in the use of the written and spoken word, (2) a sincere concern and respect for the rights and feelings of others, (3) the highest degree of Christian character in all activities. Finally, the program should give him (1) aid in securing a position following graduation, (2) follow-up services.

In terms of the standards just listed, the writer evaluated the program in music education at Capital University on a five-point scale as follows: (1) highly effective, (2) effective, (3) adequate, (4) less than adequate, (5) weak. Comparisons were made with the music education programs of two other colleges where data were available.

These evaluations and comparisons are as follows:

1. In developing skill and understanding in the theory

of music: Capital University—Adequate; Others—Effective

2. In developing skill and understanding as an interpreter and performer of music: Capital University—Effective; Others—Adequate

3. In acquiring information and understanding in the history and appreciation of music: Capital University—Adequate; Others—Effective

4. In developing skill and understanding in creativeness in music: Capital University—Weak; Others—Adequate.

5. In developing skill and understanding in all phases of voice work to the best of his ability: Capital University—Effective; Others—Adequate

6. In developing skill and understanding in all phases of piano work to the best of his ability: Capital University—Adequate; Others—Adequate

7. In acquiring an understanding of the relation of music to other arts: Capital University—Less than adequate: Others—Weak

8. In acquiring information, skill, and experience in all families of instruments: Capital University—Adequate; Others—one, Effective—the other, Less than adequate

9. In developing musically to the capacity of his ability as indicated by tests and auditions: Capital University—Adequate; Others—Less than adequate

10. In developing skill in imparting understanding and techniques to others: Capital University—Effective; Others—Effective

11. In acquiring understanding of how children grow and develop: Capital University—Adequate

12. In becoming competent in planning worthwhile experiences with boys and girls: Capital University—Effective

13. In developing skill and understanding in working effectively with pupils, staff, and community: Capital University—Effective

14. In acquiring an understanding of the value of music in everyday life: Capital University—Effective; Others—Adequate

15. In acquiring an understanding of the organization, management, and objectives of the public schools: Capital University—Adequate

16. In developing mental, physical, and personal qualities essential in a successful teacher of music: Capital University—Effective

17. In acquiring a broad cultural background: Capital University—Less than adequate: Others—Adequate

18. In acquiring an understanding of current social problems: Capital University—Less than adequate.

19. In developing skill and understanding in solving problems in an intelligent manner: Capital University—Adequate

20. In developing skill and ability in the use of the written word: Capital University—Adequate

21. In developing skill and ability in the use of oral language: Capital University—Less than adequate

22. In developing a sincere concern and respect for the rights and feelings of others: Capital University—Adequate; Others—Less than adequate

23. In developing the highest degree of Christian character in all activities: Capital University—Effective

24. In receiving aid in securing a position following graduation: Capital University—Adequate

25. In receiving follow-up services: Capital University—Weak

These findings indicate that Capital University is doing as well as the other two institutions in preparing teachers of music for the public schools, that the program of music teacher preparation at Capital University does not vary far from that of other institutions, and that, in general, the alumni, students, public school administrators, and co-operating teachers are reasonably well satisfied with the program.

In view of the strengths and weaknesses of the music education program at Capital University as indicated in this evaluative study, it is recommended that:

1. Creativeness in music be encouraged at every opportunity to develop teachers who understand and have experienced the creative approach to musical development

2. The piano staff continually press for more effective sight reading ability, accompaniment work, and improvisation of accompaniments in order to make piano study more functional for the prospective music teacher

3. The general education area of the music education curriculum be reviewed with emphasis upon the development of a broad cultural background for students

4. The entire professional education area of the music education curriculum be reorganized to meet the needs of all prospective teachers and eliminate duplication of subject-matter presentation

5. Develop a more comprehensive understanding of the relation of music to the other arts to aid the prospective music teacher in developing ability to integrate music with the other arts

6. Follow-up services be provided for all graduates to provide aid in in-service growth

7. One semester of speech be required for all students in music education to help them become more effective in oral language

8. All instrument class courses be reorganized to help prospective music teachers understand the teaching, repairing, and playing the various instruments

9. The theory area be reorganized in order that a greater degree of integration in the area may be accomplished

10. A freshman course be introduced to serve as an "Introduction to Music Education" to aid new students in understanding the aims and objectives of the public school music program and the way the Capital University music education curriculum meets the needs of prospective music teachers

11. The elementary music methods classes be combined into one three-hour credit class for one semester to present the problems of the elementary music teacher as a complete entity

12. More emphasis be placed upon an understanding of the value of music in everyday life, that music teachers may be prepared more adequately to help others find greater joy and understanding in music

13. The course in school management for prospective music teachers be reviewed to meet more effectively the needs of prospective teachers for a more complete understanding of the organization and management of the school

14. String classes be offered during the freshman year to encourage the development of more graduates who are effective as string teachers and performers on string instruments

15. The history of music and music appreciation areas be reorganized in order that students may acquire a broad background of music of all types from each period in history

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

16. The orchestration class be reorganized to provide prospective music teachers with experience in practical band and ensemble arranging

17. The course in educational psychology for prospective music teachers be reviewed to meet their needs for a more complete understanding of children and how they learn

18. The public school music orchestra course be reorganized to include both band and orchestra materials which may be used in the public schools, to acquaint prospective music teachers with the available materials through practice in playing and conducting

19. The music education curriculum be revised to allow a variety of general education courses as electives and to permit omission of the teaching minor in order that the student may elect a greater variety of cultural courses

20. A course in music acoustics be added to the music education curriculum to give the prospective music teacher a background in the science of sound

21. The guidance program for the music education majors be reorganized to provide more personalized service to prospective music teachers

22. Elementary and secondary school classroom participation to accompany each methods class to aid the prospective music teacher in establishing relationship of theory with actual practice in the classroom

23. Student teaching experiences to include more than one period per day of teaching to aid the prospective music teacher to acquire the feeling of a normal teaching situation

24. Observations be completed as a class group in order to enrich the college classroom discussion and contribute to the practical aspects of the class

25. The student teaching area be examined continually for a more effective plan of operation for Capital University

26. Consideration be given to condensing the work of the class in sight-singing and ear-training into two years, in order to concentrate the musical development of the prospective music teacher

27. The course in choral conducting be reorganized to provide more experience with school music materials for prospective music teachers

28. The elementary vocal conducting the the elementary instrumental conducting classes be taught as one course (for one semester with two hours credit and two meetings each week) in order to avoid duplication of materials in the background of conducting techniques

29. More opportunity be provided for public solo performance by prospective music teachers to give them opportunity to share performance ability with others and to develop poise and graciousness when appearing before an audience

30. More emphasis be placed upon small vocal and instrumental participation for prospective music teachers to give them opportunity to develop techniques of ensemble work and to acquire a knowledge of available ensemble materials

31. Develop a greater awareness among the faculty and graduates regarding the importance of drawing more promising musicians to the campus to maintain enrollment, uphold standards, and attract and hold competent faculty members

32. The professional education program to include at least one experience in working with parents and teachers as well as pupils of the school to aid the prospective music teacher to develop more effective skills in human relations Microfilm $3.80; Xerox $12.80. 294 pages.

1. "Evaluative Schedule." American Association of Colleges for Teacher Education, 1948.

2. "Standards for the Evaluation of the College Curriculum." Music Educator's National Conference, 1953.

3. "Measures of Teacher Competences." National Commission on Teacher Education and Professional Standards, 1953.

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AN INVESTIGATION OF FACTORS RELATED TO PROFESSIONAL UNDERSTANDINGS IN ELEMENTARY EDUCATION

(L. C. Card No. Mic 59-6652)

Loren Roger Tomlinson, Ph.D.
The Ohio State University, 1954

Schools perform a vital function in a democratic society and it is of primary social concern that they be excellent. To a considerable extent, the quality of the schools is dependent upon the quality of the teachers who guide the learning process. Today, more than ever before, demands are being placed upon teachers which require of them a high level of competence.

The appraisal of teaching competence presents difficult and perplexing problems because teaching is a complex function which calls for a variety of qualities. An extensive survey of the pertinent literature revealed that although the evaluation of teachers and teaching has been the subject of a large number of investigations over a considerable period of years, there is still a need for more objective means and more efficient procedures for appraising teaching.

In view of that general need, the present study was undertaken as an attempt to analyze one factor, which is commonly assumed to be a part of the total teaching complex, namely, professional understandings in its relationships with certain major criteria usually associated with competence for teaching. Those criteria were: supervisors' ratings, scores on a psychological examination, and point-hour ratios.

Three specific purposes gave direction to the study: (1) to explore the possibilities of developing a short-form, paper-and-pencil instrument for measuring professional understandings in the field of elementary education; (2) to utilize this and other instruments in the appraisal of the professional understandings of selected prospective elementary-school teachers; (3) to determine the relationship between scores made on the instrument by individuals, their success in student teaching, and certain factors in their backgrounds.

The major instrument developed in the study was the "Inventory of Professional Understandings in Elementary Education," a short-form, objective test. Since elementary education includes a variety of understandings related to several broad general areas in the field, it was necessary to identify those areas in order to insure an adequate coverage and a balance of content in the instrument.

In an effort to establish the general areas, a study was made of the elementary-school teacher certification requirements of the several states and of the program offerings of certain representative, degree-granting institutions which were engaged in the preparation of elementary-school teachers. The requirements varied to such an extent and were so vaguely stated that neither source presented clearly defined general areas of elementary education or any sound basis for assigning weights to the areas. Consequently, a survey was made of the literature of elementary education, and ten general areas in the field were established. The areas, with a brief description to indicate the content of each, are as follows:

I. Child Development.—Principles of human growth and development in physical, mental, social, and emotional aspects

II. General Curriculum, Methods, and Materials.—Principles and practices related to the elementary school curriculum, methods of teaching, and instructional materials

III. Guidance.—General problems of elementary school guidance including evaluation and measurement, exceptional children, recording, reporting, and promotion

IV. Professional Appreciations.—The role of the elementary school in society, and professional and public relations

V. Language Arts.—Purposes, principles, and methods of teaching language arts in general, reading, oral expression, and written expression including handwriting and spelling

VI. Social Studies.—Purposes, principles, and methods of teaching the social studies in the elementary school with emphasis upon the unit of work

VII. Mathematics.—Purposes, principles, and methods of teaching mathematics in the elementary school

VIII. Science.—Purposes, principles, and methods of teaching science in the elementary school

IX. Physical Education and Health.—Purposes, principles, and methods of teaching physical education and health in the elementary school

X. Creative Arts.—Purposes, principles, and methods of teaching music, fine arts, and applied arts in the elementary school

For each of the areas, 120 multiple-choice items with five response options were prepared. The items were developed and selected according to established criteria, and, in so far as possible, they called for the application of philosophy, psychology, and pedagogy in the selection of materials and procedures in the field of elementary education, as well as a knowledge of subject matter.

After the items in each area were developed, grouped, and coded, they were submitted to competent consultants for critical review. Their criticisms and suggestions were taken into account in the final revision and grouping of the items. The 120 questions in each area were arranged into two mimeographed test booklets of 60 items each.

The original 1,200 items were administered to selected classes of undergraduate students in elementary education. The purpose of the preliminary administrations was to establish the validity of individual items by determining through item analysis techniques the extent to which each item in a given area discriminated between those subjects who had superior and inferior scores on the test for that area. Of the 120 items in each area, the 60 items with the highest discriminative values were selected and reassembled for a second administration to different groups of undergraduates. From this second administration of 60 items in each area, the 12 items from each area with the highest discriminative values were identified. In this manner the 120 items with the highest discriminative values of the original 1,200 items were selected for inclusion in two final 60-item forms of the test.

In order to equate the final forms of the test, the difficulty level of each of the 120 selected items was computed and six items from each area were placed on each form in a manner that would equate the forms, to some extent, in terms of difficulty level.

Two rating-scale type instruments were also developed in relation to this investigation. The first of these was designed to determine the extent to which professional understandings exhibited at the intellectual level are also shown at the performance level, that is, are reflected in professional behavior in teaching situations. Because the success or failure of a teacher is also dependent upon factors other than those related directly to professional understandings and behavior, a second instrument of this type was developed as a means of obtaining for each individual an over-all rating as a teacher.

Both forms of the "Inventory of Professional Understandings in Elementary Education" were administered to a group of 78 and to a group of 44 undergraduate student teachers in elementary education and also to a group of 78 graduate students who were taking a course in elementary education. Certain different conditions which apparently affected the results prevailed in the administration of the forms to the undergraduate groups and to the graduate group. Both undergraduate groups were instructed that their scores on the forms would not influence their marks in student teaching. In addition, some individuals in those groups took Form "A" of the test first, and Form "B" second. Others reversed this procedure, and no record was made of the order in which the students took the forms. All subjects in the graduate class were informed that the test constituted a regular-course final examination and would accordingly affect their final course marks. Each of the graduates took Form "A" of the test first, and Form "B" second. Presumably the graduate group was more highly motivated and the effects of fatigue were more consistently registered in their scores on the forms.

Each of the three groups achieved a rather narrow range of scores on the two forms. The size of the standard deviations indicated that the variability of the test was small. The distribution of the form scores suggested that each of the groups was fairly homogeneous in character and that the test tended to measure understandings which the subjects held in common. The graduate group showed the widest range of scores and had the largest standard deviations, thus indicating that they were, educationally, the least homogeneous of the three groups.

The reliability of the test was estimated by computing for each group the raw coefficient of correlation between the scores on the two forms of the test. The reliability

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coefficient for the group of 78 undergraduates was.565; for the group of 44 undergraduates, .474; and for the group of 78 graduates, .717. The fact that the highest reliability coefficient was obtained for the graduate group probably resulted from the less homogeneous character of that group and from the different conditions of administration of the test forms. A reliability coefficient of .717 is comparable with those for other tests of this type and, all factors considered, was judged to be satisfactory.

It was of primary concern in the present investigation to establish the validity of the test of professional understandings in terms of an internal criterion, and this was done in the process of its construction. There are at least two reasons why the application of an external criterion of teaching efficiency is not a dependable procedure for validating a test of this type and why high correlations cannot be expected. First, teaching is a complex of many qualities and functions, and there is a lack of an objective, detailed definition of teaching ability which can serve as a criterion. Second, a test which purports to measure only one factor of the total teaching complex could not be expected to show a high statistical relationship with a composite of factors which make up a criterion of teaching efficiency.

With those limitations in mind, an attempt was made to apply external validation procedures. Using the two groups of undergraduate student teachers as subjects in this phase of the investigation, the writer assembled the following data for the individuals of the two groups: scores on the two test forms; student teaching marks; point-hour ratios in professional courses; scores on the Ohio State Psychological Examination; and, for those whose scores fell in the upper and lower quartiles of the combined forms score distribution, scores on the two rating scales.

As a group, those students whose scores on the tests were superior showed consistently higher achievement in the academic areas represented by the point-hour ratios and the scores on the psychological examination. There were no marked distinctions between the upper and lower quartile groups in those areas related to performance in student teaching as represented by scores on the two rating scales and student teaching marks.

Coefficients of correlation were also computed between all of the variables except the scores on the two rating scales. Because these forms were completed for only a part of each group, it was not feasible to include them in these computations. Inspection of the scores on the rating scales, however, revealed that they were closely related to student teaching marks.

The coefficients of correlation between the variables for the two groups of undergraduate student teachers are presented in Tables I and II. The tables reveal that no single factor under consideration showed a significantly high degree of relationship with teaching success as measured by student teaching marks. The scores on the two forms of the "Inventory of Professional Understandings in Elementary Education" show a markedly higher correlation with professional point-hour ratios and scores on the Ohio State Psychological Examination than with student teaching marks.

A combination of the score on the psychological examination, the professional point-hour ratio, and the two scores on the test forms was correlated with student teaching marks. The multiple coefficient of correlation obtained for the group of 78 undergraduates was .297 and for the group of 44 undergraduates .241. Indications are that other measurements would have to be added or the basis for supervisory judgments be stabilized before a dependable prediction of success in student teaching could be made.

TABLE I

INTERCORRELATIONS BETWEEN FIVE VARIABLES OF THE GROUP OF 78 UNDERGRADUATES

	A	B	C	D	E
A Test Form A		.565	-.066	.279	.299
B Test Form B			-.151	.333	.474
C Student Teaching Mark				.191	-.147
D Professional Point-Hour Ratio					.403
E Ohio State Psychological Exam					

TABLE II

INTERCORRELATIONS BETWEEN FIVE VARIABLES OF THE GROUP OF 44 UNDERGRADUATES

	A	B	C	D	E
A Test Form A		.474	.142	.470	.500
B Test Form B			-.025	.422	.383
C Student Teaching Mark				.157	.166
D Professional Point-Hour Ratio					.511
E Ohio State Psychological Exam					

While the findings reported here do not differ markedly from those of other studies of this type, they must be interpreted on the basis of the experimental pattern and the measures obtained in the present investigation. The coefficients of correlation cannot be taken at face value because they are relative. Neither the sample, the measures, the procedures, nor the criterion warrants sweeping conclusions.

Two factors particularly seemed to have had adverse effect upon the size of the correlations. It has been suggested previously that the groups were of such homogeneous nature that the test of professional understandings did not make distinctions among the individuals of sufficiently fine gradations to be highly useful. In addition, evidence was presented in the research report to show that there were numerous opportunities for errors and inconsistencies in judgment to occur when the supervisors awarded the student teaching marks and completed the appraisal forms.

It is quite clear that professional understandings as defined and measured in the investigation did not influence

success in student teaching as represented by the marks of these student teachers. It is quite probable that in the closely guided student teaching situation the personal and social qualities of the student teachers may be the major determinants of student teaching marks. It would seem, however, that if professional understandings as identified and measured here are desirable attributes of the successful teacher, they should be reflected to a greater extent in the student teaching marks.

This study represents only one of several approaches to the problem of developing and validating a test of professional understandings in the field of elementary education. One promising procedure would involve intensive investigations to determine the principles which are basic to the field or to general areas of the field. Items then could be designed to test the understandings of the established principles and these items could be refined through repeated administration, analysis, and revision.

Regardless of the procedure used in the development of such a test, it would be useful to determine the performance of the instrument in a large and varied sample of in-service teachers under conditions of high professional motivation. It would also be worthwhile to use the test in conjunction with a variety of other types of measures to secure a multiple coefficient of correlation with a carefully established criterion of teaching efficiency.

Materials such as the items developed in the present study could conceivably be used for evaluation purposes in a variety of ways in preservice and in-service teacher education programs. They should prove to be of particular value when used for diagnostic purposes. Since they often illustrate basic principles of elementary education and call for penetrating professional understandings, they could serve as stimulators of discussion in college classes and in faculty meetings.

A basic assumption underlying the study was that one of the major needs in education is for a procedure for determining the level and adequacy of the professional understandings of those entering and those engaged in the occupation of teaching. The fact that the scores on the test developed in this study revealed significant relationships with professional point-hour ratios and the scores on the Ohio State Psychological Examination demonstrates that there is such a body of professional understandings. It also demonstrates that the procedure used in the present investigation offers a practical approach to the problem of distinguishing among levels of professional understandings. The extent to which professional understandings affect teaching success needs to be determined by subsequent research under carefully controlled conditions.

Numerous attempts to measure the professional knowledge of teachers have been made previously. In so far as this investigator was able to discover, the present study constitutes the most comprehensive and detailed approach ever undertaken in the investigation of professional understandings in the field of elementary education. However, the findings are not conclusive. A considerable amount of further research is needed to verify or refute the findings and to exhaust the possibilities of this approach. Although a number of the results are negative in character and some appear illogical, others shed light upon the nature of educational understandings of a professional nature and make the evaluation of teaching an even more challenging problem. Microfilm $3.85; Xerox $13.00. 297 pages.

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EDUCATION, THEORY AND PRACTICE

AN ANALYSIS OF SCIENCE INTERESTS OF SELECTED CHILDREN AND AN IDENTIFICATION OF PROBLEMS ENCOUNTERED BY THE TEACHERS OF THESE CHILDREN IN SCIENCE INSTRUCTION

(L. C. Card No. Mic 59-6427)

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The University of North Carolina, 1959

Supervisor: Carl F. Brown

The purpose of this study was to discover the scientific interests of boys and girls in the upper elementary grades. It was conducted in selected areas of Texas during the school year of 1958-59. Interest sheets were administered to 3,348 boys and girls in grades four, five, and six. Teacher questionnaires were administered to 91 classroom teachers, specifically the teachers of the children inventoried.

This study attempted to reveal any changes or trends in children's science interests characterized by space flight, atomic energy, and increased media of mass communication. Differences in the science interests between boys and girls, differences in interests at specific grade levels, and the differences in interests found in school populations of city, town, and rural schools were analyzed.

Two instruments were administered; one was devised to discover the science interests of children and the other was designed to identify the instructional problems encountered by the teachers of these children. Other information obtained from the teacher questionnaires concerned the use of community resources, the number of science courses taken by each teacher at a college level, and the presence of or need for additional training in science.

The results from the interest sheets administered indicated a continuing interest among all children inventoried in all phases of astrophysical science, in the earth and its surface, in the ocean, in animal life, and particularly in TV, radio, and radar. Over thirty per cent of the boys indicated interest in jets, airplanes, motors, and electronics, followed by slightly less preference shown for space flight, animal life, astronomy, and the earth's surface. Over thirty per cent of the girls, on the other hand, indicated high interest in astronomy and in animal and plant life. Slightly fewer girls showed interest in TV, radio, and radar, in the earth and its surface, in planets, and in weather.

There were some variations in interests between grade levels. More girls in the fifth and sixth grades indicated an interest in the human body and in health and disease than did other pupils. More boys of the fifth and sixth grades indicated interest in the solar system, in rocks and minerals, and in motors than was indicated by boys of the fourth grade. More boys and girls in the rural and town areas evidenced interest in science than did those in city schools.

From the teacher questionnaires these results were observable. Teachers encountered many difficulties in science instruction such as lack of equipment and materials, lack of books, lack of space, and lack of time. A need for better scientific background was expressed by the teachers even though they had taken an average of 2.11 science courses each at the college level. Many of

them indicated a desire for some sort of training program in elementary science. A need for more adequate utilization of community resources was noted from the study.

Microfilm $2.50; Xerox $6.80. 141 pages.

SOME CONTRIBUTIONS OF FOREIGN FOLKLORE TO THE SECONDARY SCHOOL CURRICULUM

(L. C. Card No. Mic 59-6615)

Edward David Allen, Ph.D.
The Ohio State University, 1954

The Study

There exists a large reservoir of valuable learning experiences in the field of foreign folklore which has remained virtually untapped because most schools and colleges either are unaware of the potentialities of this specialty or lack the techniques for its implementation. The term folklore as it is used in the twentieth century refers to the traditions, customs, superstitions, cures, handicrafts, tales, songs, and dances which have been handed down from one generation to the next among the uncultured or unschooled country folk. It has been called the soul of the people.

Some educators who are cognizant of the need for developing in students an understanding and appreciation of foreign cultures turn to the history of other countries for the solution of this problem. History, however, deals principally with rulers and military leaders, not with the daily life of the common man: the farmer, the miller, the blacksmith, and the river boatman. The study of folklore provides the most effective means of gaining insights into the thoughts and feelings of people — both past and present. Experimentation has shown that activities involving the use of folklore, such as folk festivals, are particularly suited to the needs, problems, and interests of high school youth.

The setting for most of this study was the University School, a department of the College of Education of the Ohio State University. Students in foreign language classes at the University School planned and produced several folk festivals. This entailed a deep and extensive study of French and Mexican folklore. Detailed accounts of how the pupils evolved these festivals are presented in four resource units.

The purposes of the dissertation are: (1) to analyze the values of a study of foreign folklore in the secondary schools; (2) to make a brief survey of the present use of folklore in American schools and colleges; (3) to present four resource units which have evolved from three years of experimentation at the University School, Ohio State University; and (4) to evaluate these resource units in terms of their underlying concepts.

Limitations of this study follow: (1) it stresses certain aspects of folklore and gives scant attention to others— In length of treatment, folk-dancing is first; folk songs, second; costumes, third; legends and tales, fourth; (2) most of this study deals primarily with the folklore of only two civilizations — French and Mexican; and (3) data concerning the educational use of foreign folklore are not abundant from schools other than the University School, Ohio State University.

The Values of Foreign Folklore Study in the Secondary School

A study of folklore can provide the following values in the secondary school curriculum: recreational, neuromuscular, social, historical, geographical, aesthetic, literary, and civic. The joy derived from folk dancing and folk singing is sufficient justification for their inclusion in the secondary curriculum. Folk dancing provides vigorous physical exercise and contributes to the development of grace and coördination. High school boys and girls need the socialization which folk dancing offers. Barriers of class and race tend to disappear while children are folk-dancing; there is a strengthening of community ties. In the learning of folk dances, songs, or legends, pupils increase their knowledge of the history and geography of foreign cultures. New insights are gained into the life and culture of foreign peoples; this in turn leads toward a better understanding and tolerance of other countries. Because the study of folklore aids in building world citizenship, it deserves an important place in general education. Foreign language study can be meaningless without the concomitant cultural learnings which spring from folklore. The aesthetic aspects of folklore help to meet the creative and artistic needs of high school boys and girls. The study of folklore cuts across subject fields, therefore, it is an effective means of integration. Through consciously experiencing the emotional, intellectual, spiritual, and physical aspects of folklore, the individual is moving toward the development of a more integrated personality.

The Present Status of Folklore Study in American Secondary Schools and Colleges

The growth of folklore courses in American colleges and universities between 1940 and 1950 was significantly large. In 1940, twenty universities and one college offered folklore courses; in 1950, the number rose to thirty-eight universities and seventeen colleges.[1] Although the content of most of these courses deals primarily with American folklore, some of the material relates to the heritage of America's immigrants. There are opportunities to study the folklore of the Pennsylvania Dutch, of the early Spanish settlers in the west, and of the French colonists in Louisiana. A few colleges and universities do not list foreign folklore courses in their catalogues but integrate the study of this field in their curricula. Such is the case at the New Jersey State Teachers College at Montclair, where the Foreign Language Department presents an annual folk festival as the climax of the entire year's work. Materials for these festivals are secured by students who study abroad for one year.

Some high school programs have long included certain phases of American folklore, such as square-dancing and the reading of folk tales. Few, however, have made use of foreign folklore study. Through the influence of Montclair State Teachers College several secondary schools in New Jersey have been producing elaborate folk festivals. Foreign language teachers in a small number of schools scattered throughout the nation have been sponsoring similar programs. However, folk dancing has usually originated in physical education departments. With the leadership of such organizations as the Folk Dance Federation of California, the trend may shift to include the contributions from all related areas of the curriculum.

Resource Units on Folklore Developed at the University School, Ohio State University

Three of the resource units included in the study are on former provinces of France — Brittany, Alsace, Burgundy, Savoy, and the Basque country; the fourth is on Mexico. Preceding the unit on Brittany is a list of objectives and suggested learning activities which apply equally well to all the resource units in the dissertation. Each resource unit contains authentic information on the history, geography, people, customs, language, costumes, art or handicrafts, legends, tales, songs, and dances of a particular region. This is followed by a description of the day-by-day activities of the University School pupils and teachers as they planned and produced the festival. Detailed directions on how to make the stage properties and costumes, and how to perform the dances are found in each unit. The concluding pages of the four units offer evaluation techniques and bibliographies for pupils and teachers. Synopses of the four festivals are presented.

Brittany

The scene was a little port on the coast of Brittany. Blue fishing nets were suspended from the housetops to dry. Along the beach there were two dolmens and a menhir. The girls wore white lace coiffes (headdresses) from the regions of Pont-Aven and Finistère. The village sailors had just returned from their nine month fishing voyage in New Foundland. The people were making ready for a festival to celebrate the safe return of their loved ones. Before the merrymaking began, all the villagers took part in the pardon (religious procession). The pardon is led by a priest holding a large wooden cross. Sailors carrying replicas of their schooners also figured in this procession. As they marched, all sang the Breton national anthem. At the conclusion of the pardon, the cast sang and dramatized a song entitled "Les Filles de Pont-Aven." The final portion was the performance of the following dances: "Danse des Bergers," "Danse des Baguettes," "Piler-Lann," and "Le Jabadao."

Alsace and Burgundy

The backdrop depicted several typical Alsatian houses. On the chinmey of one house there was a stork standing upon its nest. To the strains of a recorded Alsatian band, a procession of happy villagers came dancing to the public square. The girls wore huge black or red bows called les grands noeuds. The boys were garbed in blue peasant smocks. After the mayor was offered a glass of the local wine and a piece of kugeloff (an Alsatian cake), he gave permission for the festival to begin. The group then performed an Alsatian waltz, polka, schottishe, and mazurka.

The second part of the program featured a group of visitors from Burgundy who entered the scene singing "Joyeux Enfants de la Bourgogne," and pushing a large keg of Burgundy wine. The Burgundian girls wore three types of hats: the one from Bresse was a large black lace hat resembling a lampshade; the one from Mâcon, also of black lace, was in the form of a large spool after the thread had been removed; the one for daily use was a simple white bonnet. The boys were clad in blue smocks and stocking caps. All the Burgundians wore wooden shoes which they kept on while dancing "Le Chibreli" and "Le Quadrille." Other dances executed by the Burgundians were "Le Branle a Six" and "Le Rigodon Bourguignon." After the dances, many members of the cast took part in folk games, such as Le Jeu du Chausson, Le Jeu Qui Guigne, and Le Jeu du Bourdon. In order to emphasize the process of wine-making, the Burgundians sang and dramatized the song "Plantons la Vigne."

Savoy and the Basque Country

A village in the foothills of the Savoy Alps was the scene for this festival. In the background the snow-clad Alpine peaks rose majestically above the chalets. The girls wore la frontière, a characteristic regional headdress which looks like a black velvet or corduroy baby bonnet decorated with gold trim around the border. The boys were garbed in blue smocks and berets. Festivities began with the dramatization of two famous folk songs, "Joli Tambour" and "L-Amoureux Préféré." Then the following dances were performed: "Le Rigodon Dauphinois," and the Savoyard polka, schottishe, mazurka, and "Rigodon."

As the dancing ended, a group of visitors from the Vasque country arrived at the village. The girls were clothed in scarlet skirts, white blouses, black bodices, espadrilles (sandals), and headdresses consisting of knotted white hankerchiefs. The boys wore scarlet berets, white shirts and trousers, and green sashes. Red, white, and green are the colors of the Basque flag. The male dancers, who were extremely athletic, executed the strenuous acrobatic dances entitled "La Danse du Chef Mort" and "La Danse des Gros Bâtons." "La Matelote" was a dance performed only by girls. This was followed by "Le Fandango," the national Basque dance in which all the Basques participated.

Mexico

The festival began with a corrida de toros (bullfight). As "La Virgen de la Macarena," traditional overture music, was broadcast, the bullfighters strutted into the arena. A few moments later, a trumpet heralded the entrance of the bull. The toreros met the bull with their capes. Then the bandarilleros leaped forward and sank the bandarillas (barbed wands) into the flanks of the beast. Finally the matador unsheathed his sword and killed the bull. For his brave actions, the matador was permitted to cut off the ears and tail of the animal. The cheering crowd then witnessed the following Mexican dances: "Chiapanecas," "Zandunga," "Los Viejitos," and "La Bamba." Some of the girls wore china poblana costumes, which are composed of white blouses worn with red skirts on which the emblem of Mexico is emblazoned. Other girls were dressed in the flowered huipil (headdress) and skirt of Tehuantepec. The boys were clad in white shirts and trousers, red sashes, sombreros, and serapes. Several boys and girls dramatized in Spanish the internationally-known tales "Jack and the Beanstalk" and "Little Red Ridinghood." A group of mariachis (Mexican cowboy singers) serenaded the girls with "Cielito Lindo," "Amor," and "Adiós Muchachos." As is the custom at all Mexican fiestas, the concluding dance was "El Jarabe Tapatío," the national hat dance of Mexico.

The Underlying Concepts of Folklore Study

In the process of planning and producing the folk festivals, the writer was able to arrive at a number of concepts which elucidate the contributions of foreign folklore study

to the development of high school youth and to the enrichment of the secondary school curriculum. Out of these resource units grew the following eight concepts:

A. Democracy can be practiced in the planning and presenting of a folk festival

B. Folk festivals provide an excellent medium for integrating many areas of the curriculum

C. Folk festivals lead to a sense of interdependence among students and among students and faculty

D. A folk festival provides opportunities for problem solving.

E. A folk festival can make valuable contributions to an experience-centered curriculum

F. Folk costumes have symbolic significance

G. Folk-dancing provides a rich source for physical development

H. Folk festivals provide numerous opportunities for social growth and recreation.

The foregoing treatment of desirable outcomes of folk festivals at the University School is followed by a discussion of some of the undesirable consequences and suggestions for their prevention.

In addition to the results these folklore experiences, there was noticeable gain in the study of the language itself. The joint singing of songs improved pronunciation and enriched vocabulary. The research on foreign peoples and their cultures led to an increase of supplementary reading in French and Spanish. Work on the festivals occupied a small part of the total year's activities; the rest of the time was devoted to language study. The writer has observed that former University School students who figured in the festivals did very well in foreign language classes at the college level. Many alumni have returned and reported their success in college language courses.

Recommendations for Future Use of Folklore Study

The use of foreign folklore study in the creation of folk festivals at the University School has proved valuable in effecting behavioral changes consistent with the philosophy of the school. Boys and girls participating in the festivals learned the democratic values of day-by-day coöperation in planning and working toward a common goal. Many of the students achieved status and security by carrying to a successful conclusion the responsibilities which they undertook. All the young people who had a part in the productions were made aware of at least some of the rich sources of recreation, sociability, and cultural and aesthetic opportunities which the folk festivals provided. Finally, there is evidence that many of the pupils gained a sympathetic understanding and a deeper appreciation of the people whose language and culture they had studied.

The outcomes of the folk festivals at the University School suggest the following recommendations for future use of folklore study. Within the University School, those boys and girls who do not elect a foreign language should be given opportunities in other areas of the curriculum to engage in those learning activities resulting from foreign folklore study. Secondary school teachers, administrators, and particularly foreign language instructors should investigate the potentialities of folk festivals in their school programs. Colleges of education should sensitize future teachers to the contributions of folklore to the secondary school curriculum, and provide learning experiences relating to this field of study. In addition to this, prospective foreign language teachers should be helped to develop a mastery of the understandings, appreciations, and skills required to guide the planning and producing of folk festivals. Microfilm $4.35; Xerox $14.60. 339 pages.

1. Dorson, Richard M. "The Growth of Folklore Courses," Journal of American Folklore, LXIII (July-September, 1950), pp. 345-59.

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A STUDY OF CROSS-SECTION DRAWINGS USED AS TECHNICAL ILLUSTRATIONS IN HIGH SCHOOL SCIENCE TEXTBOOKS

(L. C. Card No. Mic 59-6297)

John Gordon Burdick, Ph.D.
Syracuse University, 1959

Supervisor: Alfred T. Collette

The textbooks used in secondary school science classes contain many drawings intended to clarify the written description of an object through visual presentation of its structure and, often, of the way in which it functions. These drawings are almost always cross-section drawings. This dissertation is the report of an investigation into two aspects of the use of cross-section drawings: the ease with which they are read, and the contributions which they make to reading comprehension.

It was first hypothesized that cross-section drawings are read more easily by higher than by lower grade-level students. This hypothesis was evaluated by the use of a paper-and-pencil test, which required the experimental subjects to match a perspective drawing of an object with the cross-section of the same object.

The second portion of the study investigated the hypothesis that cross-section drawings do not make as great contributions to reading comprehension as do perspective-cutaway drawings. To evaluate this hypothesis, a reading comprehension test was used which presented the same written passages to three experimental groups. These passages were illustrated in the first case with cross-section drawings, in the second with perspective-cutaway drawings, and in the third case the written passage was presented without illustrations. The subjects were required to answer questions based on the written passage. It was assumed that differences in the scores of the groups would be due to the effects of illustrations.

The results of the testing program verified the existence of the predicted difference in the ability to read cross-section drawings; students at higher grade levels are, in fact, able to read cross-sections more easily than students at lower grade levels. The testing program also indicated that neither cross-section or perspective cutaway drawings make any measurable contribution to reading comprehension.

It was concluded on the basis of similarities between the test illustrations and those found in science textbooks that textbook illustrations, when used in circumstances resembling those established as test conditions for the study, do not contribute to reading comprehension. It was further concluded that more research is necessary in the field of textbook illustrations, aimed at determining the circumstances in which illustrations may contribute to comprehension. Microfilm $2.50; Xerox $4.80. 92 pages.

A STUDY OF THE PROGRAM FOR GIFTED STUDENTS IN NEEDHAM B. BROUGHTON HIGH SCHOOL, RALEIGH, NORTH CAROLINA.

(L. C. Card No. Mic 59-6431)

Sarah Hermine Caraway, Ph.D.
The University of North Carolina, 1959

Supervisor: Luther R. Taff

The purposes of this study were: (1) to examine critically the Broughton High School program for gifted students, (2) to attempt to discover in this program materials and procedures which would seem to be educationally sound for use with other intellectually gifted secondary school students, (3) to determine the effect on academic achievement that the program seems to have had on those in the special classes for the gifted, and (4) to determine what teachers and students consider the strengths and weaknesses of the program.

The "gifted" in the Broughton program were identified as individuals who (1) had an intelligence quotient of 120 or above as recorded from the Otis Quick Scoring Mental Abilities Test or the Henmon-Nelson Test of Mental Ability, (2) had a reading ability two years in advance of normal grade ability as recorded by the California Achievement Test given in the seventh grade, substantiated by the S.R.A. Reading Record given in the eighth grade, (3) had a rate of school progress, as recorded by grades on cumulative records, which was consistent with their mental age, and (4) had, according to teacher judgment, shown initiative in attacking new problems and delving into new fields of exploration.

The program for gifted students lent itself to an experimental situation. Special classes for the gifted were set up in the areas of English, mathematics, science, and social studies. However, students were placed in no more than two special classes a day. For the remainder of the day the gifted were placed in regular classes.

Research techniques used in the study included weekly observation of the special classes, observation of regular classes, testing and re-testing of the gifted students, the giving of questionnaires to students and to teachers, and informal interviews with students and with teachers.

Results of the investigation seemed to indicate that students with superior intellectual abilities have different academic needs and interests from those of students of "average" ability; that, therefore, the gifted need different classroom objectives, materials, and procedures than those needed by other students; that the needs of gifted students can be more adequately met in a special class than in a regular heterogeneously grouped class; that the teacher is an extremely important factor in the success or lack of success of a special class; that the academic achievement of gifted students in special classes surpassed the academic achievement of the same gifted students in regular classes; and that any program for the gifted needs to be continually evaluated and revised in order to eliminate weaknesses and to foster the development of the program to its fullest potential.

Microfilm $4.10; Xerox $13.80. 320 pages.

ASPECTS OF THE EDUCATIONAL PHILOSOPHY OF RECONSTRUCTIONISM AS SET FORTH BY THEODORE BRAMELD

(L. C. Card No. Mic 59-5354)

James Wilson Comer, Ph.D.
The Ohio State University, 1953

Purpose of the Study

The dissertation is a critical analysis and appraisal of crucial aspects of a relatively new philosophy of education, reconstructionism, advanced by Theodore Brameld during the last six years. The term "reconstruction" is not new; George S. Counts and others emphasized the problem of social and educational reconstruction in the early thirties. Brameld, however, uses the term to refer to a total philosophic outlook.

The views expressed by Counts and others were widely disputed. Leading educational theorists, especially John Dewey, Boyd H. Bode, and other pragmatists, expressed opposition to the imposition or indoctrination of predetermined views of any kind in the schools. These theorists argued that the prime role of the school was to promote growth, to develop in learners the ability and disposition to think for themselves. They viewed indoctrination as incompatible with this goal. Bode, especially, insisted that teachers had neither the qualifications nor the mission to provide "blueprints" for a future social order, and that their first responsibility was to develop intelligence and promote democracy. In a democracy, Bode argued, "common interests" have the right of way over "special interests." He denied that democracy could be identified with any single economic pattern.

During the thirties the controversy concerning "reconstructionism" raged primarily within the progressive education movement. Reconstructionism was not then conceived of as a separate philosophy of education. Not until Theodore Brameld began delineation of the movement in articles[1] in the forties did reconstructionism emerge as a distinctive philosophy. His two books[2] in 1950 depicted reconstructionism as a separate philosophy,[3] similar to but distinct from pragmatism, the philosophy most nearly the basis of progressive education.

Brameld has advanced the philosophy of reconstructionism as a theoretical basis for an education appropriate to our "crisis culture." Reconstructionism purports to be the needed successor to "progressivism." It is a comprehensive philosophy complete with an "ontology," a theory of knowledge, a theory of values, and proposals outlining a curriculum and educational methods. The general theme of the philosophy is that our civilization has reached a

critical juncture in which it is necessary to replace our profit-motivated "free enterprise" economy and society with a new social order designed for human welfare, including public ownership of natural resources and strategically placed industry. National sovereignty must now be subordinated to international authority. Education and politics are envisioned as the means to the achievement of the new social order. Education is to be utilized to secure commitment to specific values, goals, and "blueprints" proposed in reconstructionism, and these, in turn, are to be implemented through majority rule. Selected crucial aspects of reconstruction are the subject of this study.

Materials and Methods

The materials used include the published works of Theodore Brameld and other writings relevant to a study of reconstructionism. John Dewey and Boyd H. Bode are prominent among the writers advocating pragmatism, the nearest philosophic "relative" to reconstructionism. Pragmatism also epitomizes "liberalism" and "progressivism," against which reconstructionism purports to be an improved "radical" departure.

The method of critical analysis employed in the study utilizes numerous quotations, exposition, comparisons and contrasts, and logical inquiry into the beliefs and educational proposals advanced by Brameld. The effort is made (1) to define and clarify reconstructionist concepts where needed; (2) to depict beliefs and proposals of reconstructionism; (3) to appraise beliefs by inquiry into their supporting facts and logic; and (4) to inquire into the implications of the educational proposals that accompany the philosophy. Specifically, criteria for appraising the philosophy include internal consistency; conformity to known facts, or reasonable and balanced emphases and estimates; workability of proposals; tenability of hypotheses; an estimate or prediction of concomitant effects; and tenability of the explicit and implicit values of reconstructionism.

The study begins with an expository statement of reconstructionism, after which seven crucial aspects of the philosophy are subjected to critical analyses. The selected aspects are (1) "prehension," an aspect of the theory of knowledge; (2) the role of emotion; (3) the means-ends relationship; (4) ontology; (5) truth by social consensus; (6) theory of values; and (7) "defensible partiality."

Prehension

A method of direct intuition called prehension constitutes a distinctive and crucial part of the theory of knowledge of reconstructionism. Brameld borrowed the term "prehension" from Alfred North Whitehead, but he uses it to designate a method of knowing which has much in common with Harold Rugg's concept of "primal awareness." Brameld's most succinct definition of prehension is "the unity, the organic wholeness of natural events. It is a unified kind of awareness that precedes and succeeds apprehension."[3] Prehension, a kind of "total awareness" "akin to the unrational" is alleged to be an addition to "reflective, scientific analysis" as the latter is described by John Dewey and others.

Whitehead's "prehension" was found to be inapplicable to Brameld's use of the term, and Rugg failed to give a clear and consistent explanation of "primal awareness." Brameld's descriptions of the precise operation of prehension are inadequate, but any method of direct intuition such as prehension was found to be inconsistent with "reflective, scientific, analysis" to which prehension is advanced as an "addition." The conclusion reached is that prehension does not, as is assumed by the reconstructionist, operate as a method of knowing.

Were prehension to operate as assumed, its existence would preclude the reflective method of knowing to which it is alleged to be a supplement or alternate. It would rupture the integrity of the knowing process by eliminating the need for the building of meanings through experience. Neither could prehension operate without experiential knowing, for without the latter, prehension contains no adequate principle of particularity or discrimination.

The assumption of prehension, however, has harmful educational implications. In practice, emphasis would be shifted from building shared meanings and acquired valid and tested objects of knowledge to a preoccupation with knowledge alleged to be "prehended." The latter would be confused with tested and valid knowledge. Furthermore, the assumption of a direct and private road to knowledge or truth provides a dangerous instrument which may be utilized by the unscrupulous.

The Role of Emotion

In reconstructionism the emotions are assumed to operate independently of reflective experience to a larger extent than in, and in ways not accepted by, pragmatic theory. Brameld utilizes the theory of relatively detached emotions in the reconstructionist concepts which he designates as "the unrational" and "the cultural myth." These concepts are utilized in proposals designed to secure commitment to the "utopian" goals of a reconstructed social order. Detached emotions are also utilized in "prehension," in the reconstructionist's theory of truth by social consensus, in his theory of values, and in his conception of "defensible partiality."

Brameld's theory of detached emotions is based on a faulty analysis of reflective experience. His distinction between "feeling" and "how we think when problem solving," borrowed from Harold Rugg, ignores the fact that all experience, including reflective experience, begins with an "impulsion" and thus is based on feeling. Emotions can operate without reflection, since they are prior, but neither knowing nor reflection can operate without feeling.

The reconstructionist's theories, involving a separation of "warm emotion" from "cool intelligence," were found to be possible psychologically, but undesirable socially and educationally. Advocacy of beliefs and actions based on emotional commitment as distinct from critical and reflective inquiry was found, in effect, to be equivalent to subscribing to behavior uncontrolled by intelligence.

The Means-Ends Relationship

Reconstructionism owes its distinction as a new philosophy largely to the fact that Brameld contends that the pragmatic conception of ends is too tentative and too equivocal. He asserts that "it is possible to delineate not only the chief goals of most people on earth but also how they ought to seek them." In consequence, Brameld's philosophy is characterized by "magnetic foresight," by

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

stable and specific ends. Reconstructionist ends are encompassed in twelve "values" asserted to be held by "most people on earth," and in institutional "blueprints" which specify the utopian goals of a proposed reconstructed society. Reconstructionist means are conceived as "strategy," which is to be "powerful" enough to achieve the proposed ends. Educational proposals, together with political action, are conceived as the principal means of achieving the ends set forth.

Reconstructionism fails to distinguish between the roles played by differing kinds of ends; furthermore some necessary relationships between ends and means are misconceived. Brameld confuses ends which are aims, goals or ends-in-view with those ends representing completed action. He fails to recognize the hypothetical and instrumental nature of the former, and thus ignores their role as "pivots" in deliberation.

The reconstructionist's insistence on the fixity and stability of ends, and the inflexibility contributed by prior emotional commitment, together with the fact that ends are conceived independently of the means necessary to their achievement, render his ends incapable of serving instrumentally as ends-in-view. They have little or no capacity to serve in an integral and reciprocal relationship with means.

There is no adequate recognition, then, that ends-in-view are but means viewed from a more remote vantage point. The point is missed that before means can be "realized" they must be translated into means, "intermediate terms," between the remote, impressionistic goal and the concrete action. This failure to recognize the distinction --and the inevitable discrepency--between ends as goals and ends representing the close of action, yields confusion. The two kinds of ends serve different functions. The former, ends-in-view, serve as "procedural means," and the latter yield consequences and "final" or potentially esthetic experience. Confusing the two, the reconstructionist attempts to derive truth and values from the former instead of the latter.

Several undesirable concomitant results follow the reconstructionist's misconception of ends and means, and their relationship. Lack of integrity between ends and means deprives the latter of interest and results in servile, uninspiring means. Preoccupation with, and strong emotional commitment to, "stable" ends serves to obscure the multiplicity of consequences that flow from any act, and thus results in a quality of "ends justifying means." Faulty "procedural means," including bad habits, poor dispositions, possibly fanaticism, may result from commitment to ends without adequate available "material means."

Ontology

In reconstructionism the most fundamental ontological beliefs are said to be derived from pragmatism, and Dewey's Experience and Nature is cited. Distinctive ontological beliefs are claimed, however, in the area of "social reality." Beliefs ordinarily entertained as historical, political, or economic are elevated to ontological status. Both history and the future are said to be "real"; and, in particular, the utopian goals of the future are said to exert an influence on the interpretation of both history and present culture. This view is defended as both inevitable and desirable. It is argued that all history is "refashioned" in the present, with the future impinging on interpretors.

The intermittent struggle between the "forces of expansion," seeking to expand their freedom and opportunity, and the "forces of contraction," seeking to preserve their privileged and entrenched status, is attributed to history. This struggle over questions primarily economic results in wars and other conflicts, and in the long view, in the "expansion and contraction of freedom."

These and other ontological beliefs in reconstructionism result in a conceptualism that is not fully empirical. Dialecticism is rejected by Brameld, yet many of the beliefs and concepts which are advanced are so general, and so remote from concrete experience, that they defy definition and are virtually untestable. Adherence and firm emotional commitment to such beliefs yield undesirable educative results. Valid knowledge is confused with untested assumptions of what is "real," and habits of embracing assumptions through commitment or authority, instead of on the basis of critical experience, are encouraged.

Truth by Social Consensus

The reconstructionist claims adherence to the pragmatic method of truth-seeking by "experimental intelligence," but he advances an additional method of gaining truth by "social consensus." He asserts that all truth presupposes agreement, but he insists that "for those crucial purposes of goal-seeking and future making" social consensus should be "the most important single criterion."

Brameld apparently interprets " needful satisfaction" to be the pragmatic criterion of truth, and his method of "social consensus" is an added criterion designed to "objectify" pragmatic truth. His misinterpretation is based on the fact that "satisfaction" in the pragmatic view applies not to personal desire, but to objective conditions involving demonstrated performance and consequences.

The social consensus criterion is inadequate; even as is "needful satisfaction" where there is no demonstrated test. The assumption that truth may be created or validated simply by social consensus is unsound.

Educational practices based on this false conception of truth would confuse valid knowledge with dubious "truths." There would be, also, the anti-intellectual effect of devoting effort to truth-making through social consensus that should be devoted to acquiring valid objects of knowledge. Doctrinaire attitudes would replace objective quests for shared meaning.

Theory of Values

The reconstructionist's theory of values consists primarily of enunciating the specific values that are, or should be, held by most people in the world in our time. Specifically, in brief, these crucial values are "nourishment, dress, shelter, sexual expression, health, work, devotion, appreciation, creativeness, literacy, participation, and direction." All of these are said to be encompassed in the "supreme" value, "social-self-realization."

It is held that these values are derived from a study of psychology, philosophy, economics, sociology, anthropology, and the like, but it is asserted that "as they are

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tested by evidence, communication and agreement--that is by social consensus--values come within the province of truth and falsehood."

Since social consensus does not now operate as reconstructionism would have it do, the values that Brameld advances as worthy of commitment are said to be the values that social consensus would uncover were it to operate.

The reconstructionist's theory of values is inadequate. It does not reckon with the fact that values arise as a reflection of specific lacks or deprivations in an ongoing process. Its values are in the nature of "destinations" and, hence, cannot serve instrumentally in deliberation and choice-making. They are neither flexible nor specific enough to shed light on concrete situations, nor can they be revised or remade in consequence of choice and action. The prime role of intelligence, that of mediating between conflicting values, is neglected, and "commitment" is substituted.

Prior commitment to a general scheme of values would shed scant light on what is to be done in specific cases. In the lurch, snap judgments, lethargic indecision, or facile "authoritative" suggestions from those who decide what the values mean in terms of action may creep in in lieu of intellectual direction. Educative procedures stressing commitment to reconstructionist values would hinder, not aid, in making students self-directive.

Defensible Partiality

The reconstructionist distinguishes between indoctrination, which he rejects, and "defensible partiality," an invention which he advocates. The former is defined as proceeding in only one direction, "from communicator to communicatee," whereas the latter would utilize the techniques of group dynamics for "unrestricted criticism and comparison" of alternative views. The objects of indoctrination and "defensible partiality," however, are found to be the same: to secure acceptance of, and commitment to, pre-determined views.

The same objections adhere to "defensible partiality" as to indoctrination. Both interfere with the attainment of valid conclusions and objective truth by limiting the possibilities of thought in advance and by replacing doubt, a necessary ingredient of inquiry, with an attitude of certainty. Both violate the personality of students by imposing prior conceptions of "truth" and by limiting their opportunities to differ, to decide for themselves, and to grow. Both have a deleterious effect on democracy by dividing society into antagonistic, noncommunicating groups, and by discounting the effective means for the resolution of conflict--the appeal to the test of objective conditions.

Educational Implications

The beliefs and proposals of reconstructionism have implications which are educationally unsound. The general educational effect of embracing and implementing the philosophy would be a diversion of the emphasis in education from its prime function, that of developing the ability and the disposition to think and made decisions on the part of students. Instead, the emphasis would be placed on securing commitment to, and contriving means toward the achievement of, the values and goals which the reconstructionist believes are desirable and necessary in order to achieve the proposed utopian reconstructed social order. The emphasis on specific values and stable ends, together with educational proposals such as "defensible partiality," would replace the needed firm faith in intelligence. Reliance on educational practices which promote the building of shared meanings and the development of independent reflective ability would be replaced by reliance on the good will of the reconstructionist himself. This is hardly a suitable theoretical basis on which to ground a social endeavor as important as education.

Microfilm $5.05; Xerox $16.80. 395 pages.

1. Brameld, Theodore. "Philosophies of Education in an Age of Crisis," Sch. & Soc., 65, No. 1695 (June 21, 1947), pp. 449-452, and "A New Policy for A.E.F.," Progres. Ed., 25, No. 2 (Nov., 1947), pp. 252-262.

2. Brameld, Theodore. Ends and Means in Education: A Midcentury Appraisal, New York: Harper and Bros. 1950.

3. Brameld, Theodore. Patterns of Educational Philosophy, New York: World Book Co., 1950.

Abstract published by special arrangement with The Ohio State University.

A SURVEY OF THE EVALUATION OF PUPIL PROGRESS IN SELECTED ELEMENTARY SCHOOLS OF OHIO

(L. C. Card No. Mic 59-6632)

Victor William Doherty, Ph.D.
The Ohio State University, 1954

The dissertation grew out of a common interest in the evaluation of pupil progress held by the writer and two other doctoral students in the Department of Education of The Ohio State University. Under the guidance of W. R. Flesher, Head of the Evaluation Division, Bureau of Educational Research, the three students developed a plan to survey the classroom evaluation practices of teachers and the administrative policies affecting these practices in the elementary, secondary, and teacher-preparing schools of Ohio. Each student selected one of these three levels of the public school system as his area of investigation. The dissertation is a report of that part of the total survey concerning evaluation policies and practices in selected elementary schools of Ohio.[1]

The design of the dissertation consisted of (1) the formulation of principles for evaluating pupil progress which the writer could accept as a sound theoretical framework for evaluation practices in the elementary schools, (2) the validation of these principles, (3) the designing of questionnaires in such a way that data secured could be interpreted in terms of these principles, and (4) the actual securing and interpreting of the data.

The formulation of principles for evaluating pupil progress was a coöperative undertaking of the three doctoral students. To test the validity of the principles, the students devised a form on which the principles were to be rated as to their acceptance or lack of acceptance, and as to their importance if accepted. This rating form was sent to 27 persons believed by the students to have made

outstanding contributions in the field of evaluating pupil progress. A high degree of acceptance of the principles was indicated by these persons. The fourteen principles thus accepted and used as the basis for obtaining and interpreting the survey data follow.

1. Evaluation of the growth of individuals should be conducted in terms of purposes or objectives established in a clear and understandable fashion.
2. Evaluation should be a coöperative undertaking of all persons concerned with or affected by the evaluation.
3. The process of evaluating the growth of individuals should have continuity.
4. In evaluation, evidence should be gathered concerning all aspects of the growth of individuals.
5. Evaluation should be an integral part of the teaching-learning process.
6. Because of the complexity of the evaluation process, a variety of techniques, instruments, and methods should be used to secure adequate evidence of the growth of individuals.
7. Insofar as possible, evaluation should be a planned process.
8. Evaluation should include both subjective judgment and objective appraisal.
9. Evaluation should take into account differences among individuals being evaluated.
10. Evaluation should include a consideration of both the beginning status and growth of individuals.
11. Individuals should be given assistance in developing the ability to evaluate their own growth.
12. In evaluation, all available evidence should be used for the diagnosis of the growth of each individual.
13. The results of evaluation should be used in planning future teaching-learning activities.
14. Evaluation should have guidance of the individual as its primary purpose.

Although items for the questionnaires were developed in terms of the fourteen principles for evaluating pupil progress, the teachers' questionnaire was organized by areas which teachers would recognize as logical divisions of the general subject of evaluation: techniques and methods used in evaluation, scope of evaluation, cumulative records, testing practices, marking and reporting practices, and "other aspects" of evaluation (primarily pupil self-evaluation and child study services). The principals' questionnaire was designed to secure information about those aspects of evaluating pupil progress which are ordinarily controlled by administrative policy or decision: the testing program, the cumulative record system, reporting pupil progress to parents, in-service education of teachers, special personnel employed for different functions relating to evaluation, physical examination, dental examinations, and examinations for vision and hearing.

Another aspect of the design of the dissertation concerned the analysis of data. In order to determine if differences existed in the nature of responses received from certain elements of the responding population, a rather extensive analysis of data was made, using IBM sorting and tabulating equipment. Analyses were made of the questionnaire responses received from the following groups:

1. Primary, intermediate, and upper grade teachers
2. Teachers of self-contained, and departmentalized classes
3. Teachers with less than four years of experience, and those with twenty or more years of experience
4. Teachers with at least some training received since 1950, and those receiving all training prior to 1940
5. Teachers in schools having from 2 to 9 teachers, and those in schools having more than 20 teachers
6. Teachers in city-school and local-school districts
7. Teachers whose average class size was at least 35 pupils, and those whose average class size was fewer than 25 pupils
8. Teachers 20 through 29 years of age, and those 50 through 59 years of age
9. Teachers with three years of preparation, and those with five years of preparation

Questionnaires were sent to 1,998 teachers selected by a systematic, stratified sampling method designed to yield proportionate representation from four major geographic areas of the state and from the three types of school district found within these areas. A questionnaire was also sent to the 366 principals of schools to which teacher questionnaires were sent. A 43.8 per cent return was received from teachers, and a 49.2 per cent return was received from principals.

From the questionnaires received from teachers the following facts appeared to be salient.

1. Some of the most common classroom methods were rated highest by teachers as means of evaluating pupil progress. These methods included observing classroom activities, examining class written work, examining work products, listening to pupil discussions, talking informally with pupils, and planning activities with pupils.
2. There appeared to be a positive relationship between the value attached by teachers to a method of evaluation and the general serviceability of that method. For example, observing classroom activities was rated much higher than using sociograms. The former is an example of a method through which progress toward a wide range of educational objectives might well be appraised, whereas the latter is a technique for evaluating progress toward but one objective, social adjustment.
3. A pronounced positive relationship was found between the number of teachers using an evaluative method and the value rating given that method. This was true in spite of the fact that only teachers using a particular method were asked to place a value on it.
4. No type or form of testing was given a high rating by elementary-school teachers as a means of evaluating pupil progress.
5. Evaluative procedures involving observation were, in general, more highly rated than those involving the recording of data.
6. Considerable differences existed respecting ratings assigned and the percentages of teachers using methods and techniques of evaluation among teachers of the primary, intermediate, and upper grades in the elementary schools.
7. There was no broad area of pupil progress which teachers responding believed they were evaluating much

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better or worse than any other. The typical judgment was that none was evaluated adequately, but that all were evaluated fairly well. Responses to certain items indicated, however, that teachers were weak in the evaluation of attitudes, interests, and personal-social adjustment.

8. During the 1951-52 school year, educational objectives were formulated or re-examined in the schools of fewer than one-third of the teachers responding. This was true both for school and grade-level objectives.

9. There appears to be some lack of agreement among teachers regarding the meaning of the term, educational objective, and evidence was obtained to indicate that the formulation of objectives is frequently not followed by a study of ways to evaluate the attainment by pupils of those objectives.

10. From an analysis of the types of data reportedly kept in cumulative records, it appears that a large percentage of teachers do not use these records to obtain a comprehensive view of pupil progress.

11. In their classroom testing programs, teachers are more prone to emphasize the deficiencies than they are the strengths revealed in pupil performance.

12. Self-evaluation by pupils is limited, although the majority of teachers reported some pupil participation in planning class activities.

13. In the reporting of pupil progress, report cards alone or in combination with a listing of pupils traits to be checked are more widely used than any other means of reporting. Written reports to parents and parent conferences are used in a substantial number of schools, usually in combination with some type of report card, and a greater percentage of teachers using one or both of these methods expressed satisfaction with the form of reporting used than was true of teachers using report cards alone.

14. Few of the respondents assign subject-matter grades on the basis of achievement alone. Commonly given consideration in assigning grades were such factors as effort, interest, and attitude.

15. Child study services are available to fewer than one-half of the teachers responding. The types of referrals made by teachers having such services avaliable suggest that children with emotional, physical, and mental handicaps more often receive attention than do mentally gifted children.

16. A majority of teachers are not satisfied with their evaluation procedures. Lack of time was the reason given most frequently for failure to develop a good program of evaluation in the classroom.

From the questionnaires received from principals, the following findings appeared to be of greatest importance

1. Standardized testing in Ohio elementary schools appears to be extremely limited. Even in the areas of intelligence and achievement, the types of tests used and the infrequency of their application reveal a poorly balanced program. Reading tests, especially reading readiness and reading survey tests, are rather widely used. Little is being done in the testing of attitudes, interests, and personality.

2. In most instances, teachers administer and score the standardized tests used in their classrooms. Records of test results are more frequently kept in a central location than in the teachers's own records, however.

3. The design of cumulative records is characterized in many schools by the inclusion of information useful mainly for administrative purposes: school achievement, height, weight, nationality, sex, attendance data, etc. That part of the record designed for test results most frequently provides space for only the results of intelligence and achievement testing.

4. Fewer than one-half of the principals responding request complete cumulative records from schools from which children have transferred.

5. Report cards are most frequently used to report subject grades or ratings, attendance, and pupil traits, whereas such aspects of progress as health, progress according to ability, and social adjustment are much more frequently reported in written progress reports and in parent conferences than they are in report cards.

6. The use of written progress reports and parent conferences is apparently on the rise. Nearly one-third of the principals responding intend to introduce each of these two methods of reporting, while none who use them intend to discard them.

7. In-service education of teachers in the general area of evaluation appears to be extremely deficient.

8. In substantial percentages of schools, dental, visual, hearing, and general physical examinations are given with sufficient frequency to make likely the early detection and remedy of physical defects.

Those conclusions of the study which the writer believes are justifiable on the basis of the survey data secured follow. Only those conclusions believed to be of major importance are included in this abstract.

1. The scope of evaluation in Ohio elementary schools appears to be restricted largely to the measurement of subject achievement, intelligence, and, to a less extent, physical fitness to learn. Evaluation of aptitudes, attitudes, interests, environmental influences, and social relationships is neither systematic nor adequate.

2. Among the weakest elements found in the evaluation practices and programs in Ohio elementary schools were those essential to an effective guidance program: the collection of many kinds of data on pupil growth for cumulative records, the systematic use by teachers of cumulative record and standardized test results, the holding of planned pupil-teacher conferences, and the provision of child study services.

3. In general, it appears that teachers and principals do not place in proper perspective the role of educational objectives in developing programs of evaluation. There was little evidence that a close relationship exists between the formulation and acceptance of objectives and the organization of evaluation programs in the majority of elementary schools from which responses were received.

4. The many combinations of methods for reporting pupil progress reported by teachers and principals suggest that considerable experimentation is being carried on in the reporting of pupil progress.

5. There is little uniformity of practice among teachers

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respecting the factors included in subject-matter grades; this indicates that these grades are not, in the main, reliable indices of subject achievement.

6. Administrative practices relating to standardized testing, cumulative records, in-service education, special personnel, and physical examinations in general do not reflect the planned application of a philosophy of evaluation consistent with current theory.

7. In every area of pupil growth listed on the questionnaire except subject achievement, teachers of small classes (average class size under 25) believed they were doing a more adequate job of evaluating pupil growth than did teachers of large classes (averages class size over 35). Teachers of small classes also tended to give higher value ratings to different kinds of information kept in their cumulative records, perhaps indicating that they have more time to interpret the types of information kept.

8. In general, there was far more similarity than difference in the extent of use of, and the values attached to, certain techniques and methods of evaluation and the values attached to them, by those elements of the responding population among which comparisons were made.

9. Staff participation in the formulation of objectives, in the planning of evaluation in terms of objectives, and in the selection of appropriate methods of reporting pupil progress appears to be limited to a minority of schools.

The following recommendations are presented to give practical direction to teachers, principals, and others concerned with evaluation in bridging the gaps which were found to exist between evaluation in the schools and the theory of evaluation embodied in the fourteen principles presented in the dissertation.

1. In teacher-preparing institutions, all prospective teachers should be thouroghly familiarized with current evaluation theories and their development. In the practice teaching program, students should be given expert assistance in the practical application of these theories.

2. In the schools, principals should provide leadership in the development and periodic review of educational objectives, and in the development of systems for evaluating the achievement of those objectives by pupils.

3. To provide teachers with the necessary time to formulate and review objectives and to plan instruction and evaluation in terms of those objectives, boards of education should extend the period of teacher employment by approximately one month, preferably the month immediately prior to the opening of schools in the fall.

4. All aspects of the evaluation program, including classroom testing, standardized testing, health screenings, the cumulative record system, child study services, and reporting to parents, should be reviewed by teachers, both individually and in study groups, to ascertain if these different processes and instruments are serving to promote the educational objectives of the school and of their particular classes.

5. Principals should closely examine their evaluation programs to insure that no major aspects of pupil development are being neglected, using as a guide the primary objectives of the school's educational program.

6. Principals should encourage staff study of the development of a strong, teacher-centered program of guidance, and the effective utilization of cummulative records, tests, child study services, pupil-teacher conferences, and a wide range of other evaluative media in this program.

7. In the assigning of school marks, subject achievement should be rated entirely apart from conduct, attitude, interest, and effort. Independent evaluations of these manifestations of development, and comments upon them, should be made wherever it is in the interest of the pupil to do so. Until reliable indices of ability to do work in given subjects are found, it seems inadvisable to assign subject grades on the basis of pupil ability.

Microfilm $5.75; Xerox $20.60. 450 pages.

1. Titles of the two other dissertations: Robert E. Hubbard, "A Survey of Procedures for Evaluating Student Progress in Professional-Education Courses Offered by the Teacher-Preparing Institutions of Ohio," Doctoral dissertation, The Ohio State University, 1953; and Guy W. Buddemeyer, "A Survey of the Evaluation of Pupil Progress in Selected Secondary Schools of Ohio," Doctoral dissertation, The Ohio State University, 1953.

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PRACTICES IN THE SELECTION OF APPRENTICES FOR TRAINING AND THEIR RELATION TO THE COMPLETION RATE

(L. C. Card No. Mic 59-5626)

Marvin Ervin Johnson, Ed.D.
University of Missouri, 1959

Supervisor: H. H. London

PURPOSE OF STUDY: The purpose of the study was to ascertain the practices employed in the selection of apprentices in a group of apprenticeship programs, and to find out the extent to which the selection policies, practices, and devices used in the apprenticeship programs varied with the apprentice completion rate.

SOURCES OF DATA: Data for the study were obtained from representatives of apprenticeship programs who were familiar with the practices of selecting apprentices. A major portion of the study included 143 apprenticeship programs in the manufacturing industry and 46 programs in the construction industry located in the state of Illinois.

SUMMARY: The policies used in selecting apprentices for training were usually made by joint apprenticeship committees or personnel department representatives, depending upon the kind of industrial program. A majority of the selection officials reported that the major sources of applicants were either the sons and relatives of tradesmen or the companies' "present employees." The three most commonly used recruiting techniques were "regular contacts with school officials," "posting notices in the plant," and "use of present employees to help locate prospects."

The average minimum selection age for beginning apprentices was found to be 17.7 years, while the average maximum age at which persons would be considered for apprenticeship training was about 25 years. In a majority of the programs beginning apprentices were required to complete high school before being accepted

for training. Almost two thirds of the selection officials preferred that apprentices have vocational training in high school. Previous experience in the same trade or a related trade was preferred for apprentices by slightly over one half of the selection officials. Five traits considered by selection officials to be of importance to apprentices for probable success in the programs were "sense of responsibility," "industriousness," "self-confidence," " cooperativeness," and "honesty." "Mechanical abilities" and "mathematical abilities" were considered by selection officials as the two most important abilities which prospective apprentices should possess.

A majority of the officials used application forms in selecting apprentices, and the interview was used in over 90 per cent of the programs. Employment tests were used in a much higher percentage of the apprenticeship programs in the manufacturing industry than in the construction industry. The most frequently used tests were mechanical aptitude and intelligence tests. Personal references were required of apprenticeship applicants in almost three fourths of the programs. Physical examinations were required in less than one tenth of the programs in the construction industry, while such examinations were required in almost two thirds of the programs in the manufacturing industry. A probationary period of six months in length was required in a majority of the apprenticeship programs in both industrial groups.

A higher percentage of apprentices completed training in the construction industry than in the manufacturing. Apprenticeship programs in the manufacturing industry having a minimum age requirement of "over 18 years" had a higher percentage of apprentices completing training than did those programs with a younger mimimum selection age. Generally, there were few differences in the percentages of apprentices completing training in the programs in which selection officials used employment tests, interviews, and personal references in selecting apprentices, than in those programs in which those devices were not used. The apprenticeship programs having a probationary period of more than six months had a higher percentage of apprentices completing training than those which had a shorter probationary period.

Approximately one half of the respondents reported that "lack of interest in the job" was a frequent reason for apprentices discontinuing training. Apprenticeship officials reported a need for more interest and cooperation from management, organized labor, and school officials. Microfilm $2.70; Xerox $9.40. 208 pages.

AN INVENTORY OF THE AUDITORY AND VISUAL DISCRIMINATION ABILITIES OF BEGINNING KINDERGARTEN CHILDREN

(L. C. Card No. Mic 59-5724)

Alice Juanita Lewis, Ph.D.
State University of Iowa, 1959

Co-Chairmen: Dr. Louise Beltramo
Dr. Herbert F. Spitzer

The primary purpose of this study was to measure the ability of beginning kindergarten children to perform auditory and visual discrimination skills prior to systematic instruction in these areas.

The secondary purpose of this study was to determine the effect of chronological age, sex and socio-economic status upon children's ability to perform these skills.

An eighty item test consisting of items similar to those found in reading readiness workbooks was built to obtain data. The test consisted of an Auditory Discrimination Test of forty items built to measure children's ability to hear sounds in words and a Visual Discrimination Test of forty items built to measure children's ability to see likenesses and differences in geometric designs, letters and words. The Auditory Discrimination Test consisted of two parts: Part I consisted of twenty items concerned with the rhyming element in words, while Part II contained twenty items devoted to the consonant sound at the beginning of words. The Visual Discrimination Test consisted of two parts: Part I contained twenty items attempting to measure children's ability to see likenesses and differences in geometric designs and pictures, while Part II consisted of twenty items concentrating on likenesses and differences in letters and words.

The eighty item test was individually administered to one hundred and ninety-two beginning kindergarten children in Cedar Rapids, Iowa. Every eighth, sixteenth, twenty-fourth and in some cases, thirty-second child was chosen from individual class lists from each of the twenty-one elementray schools in the city. The test was administered in two sessions. The first parts of the tests were presented during the first session while the second parts were presented during the second session.

To measure the ability of children to perform the auditory and visual discrimination skills included in this test frequency distributions, means, medians and standard deviations were obtained for eighteen different groupings of the eighty items. Effects of chronological age, sex and socio-economic status upon performance were measured by employing the "t" test.

Conclusions drawn from this study are:

1. Although a small group of children apparently lacked the ability to hear the rhyming element in words, the average beginning kindergarten children were able to perform with a considerable amount of success. They answered correctly fourteen of the twenty items, or almost 75 per cent of the items.

2. A few of the children were able to hear beginning sounds in words; however, the majority of them experienced considerable difficulty. A mean score for the twenty item test was 8.9.

3. Beginning kindergarten children had little or no difficulty in seeing likenesses and differences in geometric designs and pictures. A mean score of 19.3 was obtained

for the twenty item test. In detecting likenesses and differences in letters and words a mean of 17.8 for the twenty item test showed that children had somewhat more difficulty in making discriminations with letters and words than with geometric designs and pictures. Children experienced more difficulty with words than with letters, especially when the item presented the word in both its correct and reversed form.

4. The sex factor had no significant effect upon children's performance on this test. Chronological age had a significant effect on performance. The mean score for children from the older group (65 months or older) was higher than the mean score for the younger group (64 months or younger). This difference was significant at the 5 per cent level. Socio-economic status had a significant effect upon performance. The mean score for children from the upper group (1,2,3, and 4 of the Warner Index of Status Characteristics) was higher than the mean score for the lower group (5,6, and 7 of this same scale). This difference was significant at the 5 per cent level of confidence. Microfilm $2.50; Xerox $6.00. 121 pages.

INTEGRATING RECENT SCIENTIFIC CONCEPTS INTO THE NINE-GRADE SCIENCE CURRICULUM

(L. C. Card No. Mic 59-4547)

Ahmet Kemal Özinönü, Ed.D.
University of Illinois, 1959

The purpose of the investigation was: (1) to study the meaning of "concept", and to identify basic concepts in certain areas of science, such as Newtonian mechanics, static electricity, magnetism, and quantum mechanics; (2) to integrate these scientific concepts into the high school freshmen science curriculum in the form of instructional units; (3) to determine the effectiveness of the new subject-matter content by putting it into an actual teaching-learning situation, and (4) to analyze the results and observations obtained.

The following concepts were identified: six basic observables from Newtonian mechanics, including position and momenta on a coordinate axis system, electric charge and field strength from static electricity, megnetic power and magnetic field from magnetism, nuclear force, quanta, wave and particle nature of the electron, the electron-position and electron-state from quantum mechanics. The instructional units were then organized around these basic observables. The topics within each unit were arranged so that the educational activities involved would help the students develop first a percept, then qualitative, quantitative, and abstract concepts of the particular phenomenon examined. In order to achieve this objective, the instructional units also included library references, teaching aids, laboratory experiments, reading materials, homework, and field trips.

The effectiveness of the new content was tested with a group of high school freshmen for 55 class sessions of experimental teaching. Some of these sessions were spent for the purpose of orientation, planning, and pre- and post-testing. The average I.Q. of the experimental group was 134.05, with a chronological age average of 13 years and 8 months. The development of the basic concepts and of related factual knowledge of the subjects was determined as the mean difference between their pre- and post-testing achievement scores obtained by the use of three measuring tools prepared by the investigator. They included the following tests: General Science, Concept I and Concept II. In addition, Science Form 3A of the Cooperative Sequential Tests of Educational Progress and Science Test IV, Data Sheet and Individual Information Blank were also administered. Among these, only the STEP Science Test was a standardized test.

Along with the statistical analysis of the effectiveness of the new subject-matter content, class sessions, and some special sessions during the experiment, were recorded on tape and then analyzed descriptively. The results obtained from both statistical and descriptive analyses are as follows:

1. The subjects who participated in the experiment developed the basic scientific concepts in the areas tested by Concept I and II tests. (Significant at .01 level for Concept I, and substantially close to .05 level for Concept II test.)
2. Along with their development of the basic concepts, the subjects gained basic scientific knowledge in the areas tested by General Science Test. (Significant at .01 level.)
3. While the rank correlation between the subjects' I.Q.s and their pre-testing achievement scores on General Science Test was .013, the rank correlation between the subjects' Intelligence Quotients and their success on Concept pre-testing was found .51.
4. The rank correlation between the scores obtained on General Science Test and Science Test IV was .57. General Science Test included items from such areas of science as measurement, simple machines, heat and thermometry, properties of liquids and gases, buoyancy, density and pressure; whereas Science Test IV consisted of items on atomic mechanics, theories of light, magnetism and static electricity.
5. Because of their close contact with new and different science topics, the subjects' interests were broadened and varied.
6. Throughout the study, the members of the experimental freshmen science group indicated a positive attitude toward the new subject matter content. In their response to a questionnaire, some students showed a strong desire to continue educational activities related to the new content.
7. Some subjects designed, developed, and carried on individual projects related to the areas of the experimental curriculum.

In the light of this evidence it may be concluded that: (1) basic concepts, including the ones developed most recently, can be identified for the purpose of secondary science education; (2) the concepts identified can and should be integrated into the high school curriculum, including the freshman year; (3) the high school freshman can develop these concepts if suitable learning conditions are created; (4) the inclusion of basic scientific concepts into their science courses can help high school freshmen

to develop a new interest in and a positive attitude toward science and scientific thinking.

Microfilm $3.80; Xerox $12.80. 293 pages.

AN APPRAISAL AND COMPARISON OF THE EDUCATIONAL POTENTIAL AND EFFECTIVENESS OF TWO-YEAR AND THREE-YEAR JUNIOR HIGH SCHOOLS

(L. C. Card No. Mic 59-6510)

Lowell Curtis Rose, Ph.D.
Purdue University, 1959

Major Professor: Clarence A. Pound

The purpose of this study was to arrive at conclusions relative to the educational potential and effectiveness of two-year and three-year junior high schools. The population for the study was all the commissioned junior high schools in the State of Indiana. This group of schools was appraised and rated on an Equating and Selecting Instrument, developed as a part of the study, and designed to identify the junior high schools strong in terms of criteria characteristic of good junior high school education. From the schools receiving high ratings on the instrument, a student sample consisting of 200 students, including 100 from two-year and 100 from three-year junior high schools, was selected. These students were tested to obtain data that could be manipulated to arrive at conclusions relative to the academic achievement and personal adjustment of the students from the two types of junior high schools. Appropriate statistical tests were applied to the data.

Data relative to the scores made by the junior high schools on the Equating and Selecting Instrument indicated that the three-year junior high schools were far superior to the two-year schools in terms of the criteria identified on the instrument. The mean score on the instrument for the two-year schools was 13.2 and for the three-year schools 18.6. This difference was significant at the .01 level. Further, in the schools studied, the correlation between size of the pupil enrollment and the score received on the instrument was .71. This indicated a strong relationship between the size of pupil enrollment and the potential for education as identified by the criteria on the instrument.

The mathematics and reading forms of the Sequential Tests of Educational Progress were used to test academic achievement of the students included in the testing sample. A statistical analysis of the data indicated that there was no significant difference between the scores made on the tests by students from the two types of junior high schools. Observation of the scores indicated that the scores by the students from the two types of schools were strikingly similar.

The Mooney-Problem Check List was used to determine the personal adjustment of the students included in the testing sample. The resultant data indicated that the students from the two-year junior high schools perceived significantly more problems than students from the three-year schools. The difference was significant at the .05 level.

The final conclusion was that on the basis of the data presented, there was no clear evidence to indicate that the one type of junior high school organization was superior to the other in its inherent ability to satisfy the needs of junior high school pupils. However, the evidence did indicate that where enrollments are large, the educational potential is likely to be higher; thus, in schools where the enrollments are small, the increased enrollment resulting from including grade nine in the junior high school can enhance the educational potential of that school. Further, there was some evidence to indicate that pupils in three-year junior high school tended to be better adjusted, or have less problems, than pupils in two-year schools. Further testing designed to validate or disprove the latter tendency was recommended.

Microfilm $2.50; Xerox $8.60. 190 pages.

THE EVALUATION OF ATTITUDES AND UNDERSTANDINGS OF STUDENTS IN SECONDARY SCHOOL ECONOMICS

(L. C. Card No. Mic 59-6741)

Edward Granville Sewell, Ph.D.
The University of Texas, 1959

Supervisor: J. G. Umstattd

The Joint Council on Economic Education (JCEE) and the Council for Advancement of Secondary Education (CASE) have taken the lead in focusing attention on the need for more instruction in economics on the secondary school level. An increasing number of experimental programs and use of more instructional materials in this area call for evaluation of the results. This study was undertaken to meet the need for an instrument to evaluate economics in secondary schools and to ascertain some of the attitudes and understandings of the pupils participating in this study.

The evaluation instrument of this study is in two parts, a 20-item scale for evaluating liberal-conservative attitudes and a 34-item test of understandings. The attitude scale is a Likert type summated rating scale, and the test of understandings is a multiple choice test. The instrument was planned to be administered in a 45-minute class period.

The attitude scale and the test of understandings were developed from the key understandings in economics found by CASE. Competent judges selected final items from a larger number after some suggested revisions had been made.

Nine hundred and twenty-two students in twenty-seven classes in eleven schools in eight states returned usable forms. Students in twelve classes with a total enrollment of 404 pupils took the test without prior class instruction in economics, and 518 pupils in fifteen classes took the test after at least one three-week unit in economics.

Satisfactory reliability for the attitude scale was established on the basis of a t test suggested by Allen L. Edwards and by the chance-half correlation of the odd-even items. Validity satisfactory for class measurement was established by the judging process and by a test of significance of difference in mean scores of a liberal group and a conservative group.

Reliability of the test of understandings computed by the correlation of the odd-even items and the index of

discrimination and index of difficulty also proved satisfactory. The extent of validity depends on the consensus of competent judges and a test of significance of the difference between the mean scores of groups with and without work in economics.

A partial summary of the conclusions follows:

1. The instrument is entirely satisfactory for its in tended use and on the intended level for groups. It probably has limited application for individuals.
2. There is a slight but significant positive correlation between better understanding in economics and a more conservative attitude for this group of respondents.
3. Boys are slightly more conservative in economic matters than girls and score higher in understanding of economic principles.
4. Scores in understanding are related to grade, but differences are greater between those with some class instruction in economics and those without economics than differences between grades.
5. Scores in understanding are related to amount of social studies, but the differences appear to be due primarily to differences between those with class instruction in economics and those without such instruction.
6. There is a considerable amount of inconsistency in the beliefs of secondary school pupils in economic matters.

Microfilm $2.65; Xerox $9.20. 201 pages.

VOICE MUTATION IN THE ADOLESCENT MALE: AN EXPERIMENT IN GUIDING THE VOICE DEVELOPMENT OF ADOLESCENT BOYS IN GENERAL MUSIC CLASSES

(L. C. Card No. 59-6977)

Frederick John Swanson, Ph.D.
The University of Wisconsin, 1959

Adviser: Robert G. Petzold

The Problem

Significant differences exist between the numbers of girls and boys who participate in elective music activity in grades 9 - 12. Voice mutation, which typically begins in boys in grades 7 - 8, may be one cause for this discrepancy. Three problems are considered.

1. Do any factors involved in voice mutation affect the learning outcomes in vocal music classes and explain the discrepancy between boys and girls in music?
2. Can a methodology for directing the singing activities of adolescent boys be worked out to better meet their needs during voice mutation?
3. If so, will better skills, attitudes and knowledges result?

The Procedure

Preliminary research supplemented by case studies led to these conclusions.

1. Voice change is directly related to sexual maturity. The sex characteristic most useful in predicting voice change is presence of pubic hair.
2. Voice change typically follows this pattern.
   a. The lower tones of the emerging adult voice develop first.
   b. The treble tones of the immature voice remain controllable long after mutation begins.
   c. Tones near middle-C tend to "break" and for a time cannot be controlled.

A preliminary survey of literature on methods of vocal production developed these hypotheses.

1. There are at least two registers in the singing voice.
2. Different sets of muscles or different areas of the vocal bands function as high or low pitches are sung.
3. Breaks occur because of imbalance between sets of muscles controlling the vocal bands.
4. In the rapidly growing larynx of early adolescence, the vocal apparatus is greatly out of balance; special training is needed to regain use of the singing voice.
5. Psychological implications of this loss of control may explain the boy's aversion to singing activities.

Eighty-five eighth grade boys in John Deere School, Moline, Illinois, served as experimental group; 100 boys in Coolidge School, Moline, served as controls. No significant differences in I.Q. scores, age, race, economic status, or educational background appeared. In the control school, music classes functioned as in previous years. In the experimental school, boys were scheduled for music on the basis of sexual maturity (using the Davenport scale) thus:

1. Boys 4 - 6 to same music section, no girls
2. Boys 1 - 3 to same music section, no girls
3. Boys 0 to same sections as girl classmates.

Periodically, data on vocal range and physical development were gathered. During the year, experiments were carried on in song singing, vocalising, listening, reading, motivation; methods yielding best results were recorded.

The Results

By May, the experimental boys had surpassed the control boys in number of semi-tones they could sing; twice as many experimental boys as control showed gains in vocal range.

In September, boys of both groups were equivalent in scores made on a scale measuring attitudes toward music, and were inferior to their girl classmates. By May, experimental boys had surpassed controls and were approximate to the girls; control boys had regressed to lag farther behind the girls.

Answers to a questionnaire indicated the majority of boys reacted favorably to the experimental procedures.

On a music knowledge test given in September, scores of boys in both schools were equivalent, and significantly below those of the girls. By May, experimental boys had increased significantly and were equivalent to girls, while control boys and all girls showed no gain.

Number of boys registering for ninth grade vocal music more than doubled numbers of any of the four preceding years.

Examinations of case records revealed support for the conclusions regarding voice change and the hypotheses on registers.

Conclusions

One means of correcting the discrepancy between boys' and girls' participation in vocal music involves:

1. Grouping boys homogeneously on the basis of sexual maturity, separate from girls, during early adolescence.

2. Adapting the music curriculum to the peculiar physical and psychological needs and capacities of adolescent boys.

Microfilm $4.00; Xerox $13.40. 310 pages.

ENGINEERING

ENGINEERING, GENERAL

AN INVESTIGATION OF BIOLOGICAL ORGANIZATION AS A MODEL FOR INDUSTRIAL ORGANIZATION

(L. C. Card No. Mic 59-5965)

Chester Joseph Kishel, Ph.D.
Case Institute of Technology, 1959

The purpose of this study was to investigate the similarity between biological organization and industrial organization with the intent of establishing the biological organization as a model for industrial organization.

The study develops a conceptual model of industrial organization and a conceptual model of biological organization. The models are placed in juxtaposition to determine whether an essential congruity between the two exists. The analogous biological model is then tested in the area of limited span of control theory and the theory of excessive scalar levels to ascertain its usefulness in resolving the existing conflict between the two theories.

It was concluded that an essential congruity exists between the two systems. Both organizations are coupled to the outside world for reception of impressions as well as for the performance of actions which permit survival in a dynamic situation. The industrial organization possesses a sensing, transmitting, coordinating and decision-making system closely akin to the nervous system. Industrial organizations therefore lend themselves very well to description and analysis in physiological terms. Use of the analogous biological model permitted postulating a modified theory resolving the conflict between contemporary span of control and levels theory.

Microfilm $2.50; Xerox $7.20. 153 pages.

ENGINEERING, AGRICULTURAL

THE RIGIDITY OF NAILED TIMBER JOINTS

(L. C. Card No. Mic 59-5663)

Landis Lee Boyd, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisors: Professor Henry Giese
Dr. Glenn Murphy

This study was undertaken to develop relationships describing the rotation of nailed timber joints as a function of: (1) the geometry of the joint, (2) the properties of the timber and of the nails, and (3) the forces on the joint. This information will permit the use of semirigid frame design procedures for timber structures and will receive widespread usage in the rapidly expanding prefabricated building industry. General relationships were necessary because there are no standardized nailed connections such as the riveted connections used in steel construction.

The variables considered to be pertinent to rotation in the joint were: (1) the moment applied to the joint, M; (2) the specific gravity of the timber, G; (3) the depth of the timber, d; (4) the thickness of the timber, b; (5) the length of the joint, L; (6) the number of nails used in the joint, N; (7) the distance of the nails from the center of gravity of the nail pattern, Σz; (8) the diameter of the nails, D; (9) the penetration of the nails, p; and (10) the proportional limit of the nail steel, f. Two loading conditions were considered: moment only and both moment and shear.

Theoretical equations were developed for three conditions of nail and wood performance. They were: (1) elastic action of both the nails and the wood, (2) elastic action of the nails and plastic action of the wood, and (3) plastic action of both the nails and the wood. The moment at which bending of the nails begins can be predicted from these relationships. Most of the commercially available nails will begin to bend while the wood is still in an elastic condition. Theoretical equations for rotation were not developed because slip in laterally loaded joints has been found to vary greatly from theoretical predictions.

Dimensional analysis was used to combine the variables into dimensionless groups or pi terms. This reduces the number of variables which must be investigated. It also facilitates holding at a constant value all of the variables except that which is being investigated. Models having a length scale of 4.0 were used to reduce the amount of material required and to permit simplification of the loading apparatus.

The relationships between rotation and each of the other pi terms were established from observations of five replicates of each joint which was investigated. These component equations were combined according to the principles of similitude to form general equations. Additional experimentation should be carried on to improve and expand these equations. The general equation which was developed for moment only loading is:

$$(1)\quad \theta = \left[(2.43 \times 10^{12})\,(M/fL^3)^{3.78} + (3.57 \times 10^{-5})\right] \frac{L^4}{N\Sigma z p D d G}$$

The general equation for shear and moment loading is:

$$(2)\quad \theta = \left[(2.21 \times 10^{11})\,(M/fL^3)^{3.54} + (2.46 \times 10^{-5})\right] \frac{L^4}{N\Sigma z p D d G}$$

Microfilm $2.50; Xerox $5.60. 113 pages

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

DISTORTED-MODEL THEORY IN INVESTIGATIONS OF TILLAGE IMPLEMENT FORCES

(L. C. Card No. Mic 59-5671)

Herbert Eugene McLeod, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisors: Kenneth K. Barnes
Glenn Murphy

The objective of this investigation was to develop a workable and reliable model system for investigations of tillage implement forces.

A hypothesis of the soil variables pertinent in determining the soil forces acting on a disk was made and the following complete list of variables resulted: R, a resultant soil force component; D, disk diameter; λ, any other pertinent length; V, disk velocity, g, acceleration due to gravity; α, disk horizontal angle-of-approach; β, disk vertical-tilt angle; w, soil bulk volume weight; C, apparent cohesion, ϕ, angle of shearing resistance; A, apparent adhesion; μ, angle of soil-metal friction. A torsional shear apparatus was developed for determining C, ϕ, A, and μ. From dimensional analysis and the Buckingham Pi Theorem, the following functional equation of dimensionless pi terms was written for a prototype disk:

$$\frac{R}{wD^3} = f\left(\frac{\lambda}{D}, \frac{V^2}{gD}, \alpha, \beta, \phi, \mu, \frac{C}{wD}, \frac{A}{wD}\right).$$

All model design and operating conditions, obtained by equating the corresponding independent pi terms, could not be satisfied. A distorted-model system was developed, using the same soil for model and prototype. For such a system, the dependent pi terms for model and prototype are related by a prediction factor which is a function of the distortion factors involved in the unsatisfied design conditions.

For the investigation, geometrically similar disks with diameters of 3, 6, and 12 inches were selected. The 3- and 6-inch diameter disks were treated as models of the 12-inch disk and the 3-inch also as a model of the 6-inch disk.

Any one of four soil boxes could be pulled on a track by a variable-speed drive unit. The disk being tested was suspended by six load cells employing SR-4 strain gages as force-sensing elements.

Tests were run in four soils, ranging from nearly pure sand to silty clay, for the purpose of determining a relationship between the prediction factor and distortion factors. From soil strength measurements associated with this series of tests, it was concluded that apparent adhesion was negligible and that the only significant distortion was in the pi term involving apparent cohesion. Empirical equations relating draft, side, and vertical prediction factors to this distortion factor were developed.

The functional equation for the model was

$$\frac{R_m}{w_m D_m^3} = f\left(\frac{\lambda}{D}, \frac{V^2}{gD}, \alpha, \beta, \phi, \mu, \gamma\frac{C}{wD}\right)$$

where γ is the distortion factor. Then $\frac{R}{wD^3} = \delta\frac{R_m}{w_m D_m^3}$, where δ is the prediction factor. With $\frac{R_m}{w_m D_m^3}$ determined for model and with δ determined from the value of γ, $\frac{R}{wD^3}$ may be calculated for the prototype.

The system was evaluated by a series of tests with model and prototype disks at varying velocities. Force vs. velocity curves were predicted with reasonable accuracy and with great improvement over previous attempts at such predictions with a model system based on other soil variables.

The chief conclusion from this investigation is that the distorted-model system is workable and will predict the magnitude of soil force components on a concave disk with reasonable accuracy and reliability, but that further work is needed to improve certain techniques. It is believed that the system can be extended to other tillage implements with little difficulty.

Microfilm $2.50; Xerox $6.20. 128 pages.

THE DYNAMIC BEHAVIOR OF FARM TRACTORS

(L. C. Card No. Mic 59-6508)

John Philip Raney, Ph.D.
Purdue University, 1959

Major Professor: Dr. J. B. Liljedahl

The purpose of this project was to describe mathematically the dynamic response of a farm tractor and to determine the degree of accuracy of this mathematical model.

Three degrees of freedom were assumed. These were vertical motion of the center of gravity, rotation about a transverse axis through the center of gravity and rotation about a longitudinal axis through the center of gravity. In order to check the derived mathematical model, which described the motion of the tractor under dynamic conditions, experimental tests were designed to obtain transient response and frequency response data on two different tractors. One was an International Harvester Model 450, and the other was an Oliver Model 550.

Transient response data was obtained for the IH 450 by driving the tractor over sinusoidal bumps at various speeds. Frequency response data was obtained for the Oliver 550 using a mechanical shaker which had a variable frequency and amplitude of vibration.

The analytical solutions were obtained by solving the derived system equations on an EASE electronic analog computer.

There was found to be sufficiently good agreement between the experimental and analytical results to indicate the possibility of performing reasonably accurate analytical investigations into the dynamic response of proposed tractor designs using the basic mathematical model and proper parameter values.

Microfilm $2.50; Xerox $6.60. 139 pages.

THE DEVELOPMENT AND EVALUATION OF A METHOD FOR THE CONDENSATION OF MOISTURE UNIFORMLY IN SOIL WITHOUT EXCEEDING FIELD CAPACITY

(L. C. Card No. Mic 59-3983)

John W. Wolfe, Ph.D.
Utah State University, 1959

Major Professor: Dr. V. E. Hansen

For at least fifty years irrigation scientists have wished for a method of maintaining constant moisture content in the soil while plants are growing and continually extracting it. Apparently this cannot be done by common irrigation techniques. Water applied to the soil surface does not rapidly distribute itself uniformly in the root zone unless enough is applied to bring the entire root zone to field capacity. One method has been found partially successful at low tensions, but no satisfactory method has been found for high tensions.

In this investigation, moisture was supplied in the vapor phase to a 3-inch cube of soil contained in a plastic box. Saturated air was forced through the soil from the bottom, while condensation was induced by temperature control in the soil. Temperature control was obtained by five grills made of small copper tubing at equal intervals in the soil, and passing cold, dry air through the grills.

Theoretical grill temperatures for uniform condensation were computed from the expression

$$w = \frac{0.622e}{P - e}$$

where w is specific humidity in pounds of water vapor per pound of dry air, e is the partial pressure of the water vapor, and P is the total absolute pressure of the mixture. Values for e were obtained from steam tables for saturation. Values for P had to be computed theoretically at each grill by applying Darcy's Law to flow of a compressible fluid through a porous medium, and allowing also for the lower temperature at each succeeding grill. The following typical set of grill temperatures and their corresponding gage pressures were computed, assuming a total pressure gradient from ten inches of mercury to zero:

	Grill 1	Grill 2	Grill 3	Grill 4	Grill 5
Temperature, ° C.	23.89	21.80	19.55	17.11	14.44
Pressure, in. Hg.	9.441	7.429	5.316	3.086	0.710

Difficulty was experienced obtaining a uniform soil compaction around the grill tubes. As a result, it was found necessary to adjust the grill temperatures slightly to compensate. A change of 0.02° C. was found to make a noticeable difference in the resulting condensation. After four preliminary trials and adjustments, the fifth trial produced the following moisture percentages in eight equal layers from top to bottom: 3.33, 2.58, 3.40, 3.24, 4.17, 3.74, 3.56, 3.16. The soil used was initially air dry at 0.8 percent moisture. Its wilting point is about 3.5 percent. Thus the method was successful in placing moisture with a fair degree of uniformity at a value less than field capacity, although there is still room for improvement.

The thermodynamics and heat transfer of this process were analyzed. The heat conductivity of the soil was shown to have a negligible effect on the temperature distribution between grills. The cooling effect of the expanding air on the other hand may have been more than enough to offset the latent heat of condensation, just as rising warm air does in the earth's atmosphere, causing precipitation. This idea is supported by the results of the fourth trial, during which the soil was less compacted than for the fifth trial. Results of the fifth trial show that part of the cooling was by the grills, because more moisture was condensed immediately in front of the grills than behind them. This result is supported by additional theoretical analysis, and by measurement of the temperature of the soil between grills. There was no visible evidence of resistance to wetting by this method.

Microfilm $2.50; Xerox $3.60. 63 pages.

ENGINEERING, CHEMICAL

THE FORMATION OF DETONATION IN SATURATED MIXTURES OF KNALLGAS AND STEAM

(L. C. Card No. Mic 59-6292)

Leonard Bernhard Adler, Ph.D.
Syracuse University, 1959

Supervisor: James A. Luker

An investigation was conducted to study general characteristics of the formation of detonation in saturated mixtures of knallgas (stoichiometric mixture of hydrogen and oxygen) and steam at 100°C. and to determine the experimental effects of mode of ignition and reactor geometry on the formation process in such mixtures.

The experimental method of operation consisted of the preparation and ignition of saturated knallgas-steam mixtures of varying strength in a heated reaction tube of a given length. The reflected reaction pressure of the combustion disturbance generated in each mixture was measured by a quartz pressure transducer mounted in the reactor end at a fixed distance from the ignition source: pressure records obtained in this manner corresponded to successive stages of the formation of detonation. The amount of knallgas reacted in each experimental mixture was also determined. An ignition variable was provided by the use of spark or hot-wire mode of ignition; a geometry variable was introduced by the use of reactors of different diameters.

Analyses of the experimental data were based on graphical representations of the two primary measured reaction parameters and consideration of the nature of the reaction pressure records. Necessary comparisons were made with respect to pressure levels of constant-volume explosion and stable reflected detonation obtained from theoretical calculations. The results of these analyses indicated the following with regard to the experimental mixtures:

Steam inhibited the knallgas reaction.

A true composition limit for detonation could not be determined under the conditions studied because the reactor length employed was not sufficiently long to allow the weakest detonatable gas mixture to stabilize.

The formation of detonation occurred in a manner

consistent with the generally-accepted picture of the formation process; unstable reflected detonation pressures in the formation region were approximately three times those corresponding to theoretical reflected detonation.

The formation of detonation was dependent upon mode of ignition and reactor geometry in a dual manner related to the reactor size. Spark was more effective than hot-wire ignition in forming detonation, but only in small reactors where heat losses apparently were dominant and had a selective effect on reactions initiated by each ignition source. Reactor diameter also affected the formation of detonation with a fixed ignition source: heat loss was indicated as the governing factor in small tubes where detonation was formed less readily in a narrower diameter; a converse reactor diameter-wall interaction effect was apparently dominant in a larger reactor.

Microfilm $3.70; Xerox $12.60. 286 pages.

TURBULENT DIFFUSION IN THE CORE OF FULLY DEVELOPED PIPE FLOW

(L. C. Card No. Mic 59-5973)

Lionel Vernon Baldwin, Ph.D.
Case Institute of Technology, 1959

This thesis is devoted to an experimental study of turbulent diffusion downstream of a line source of heat. Mean temperature profiles in the core of nearly fully developed pipe flow were measured at four mean velocities, from U = 73 to 160 ft/sec. Hot-wire anemometer surveys showed that the turbulence in the axial core was nearly homogeneous and isotropic. The objective was to find empirical relations between the anemometer (Eulerian) specification of the turbulence and the Lagrangian statistical properties which determine diffusion.

The diffusion results agreed with predictions of G. I. Taylor's theory of diffusion by continuous movements; the eddy diffusivity increased from zero at the source to a constant, asymptotic value far downstream. The Lagrangian correlation coefficients inferred from the diffusion data had shapes similar to the Eulerian correlations over most of the range of time and space. Empirical relations were found to relate the coordinates of the Lagrangian and Eulerian correlations. In addition, preliminary measurements are reported for a general Eulerian correlation which is a function of both space and time; the results indicate that a special case of this new Eulerian function may be a fair approximation of the Lagrangian correlation.

Microfilm $2.50; Xerox $8.40. 181 pages.

STUDY OF FACTORS AFFECTING PERFORMANCE OF PACKED DISTILLATION COLUMNS

(L. C. Card No. Mic 59-6294)

Elwood Frederick Booth, Jr., Ph.D.
Syracuse University, 1959

Supervisor: C. S. Grove, Jr.

Recognizing the need for additional information on which to base the design and operation of packed distillation columns, a study of some of the factors affecting column performance was carried out. The majority of the published data on this subject are for small diameter columns of laboratory or pilot plant scale. For this study a column of twelve inch diameter by fifty four feet high was used so as to approach plant scale operation and avoid misinterpretation of side effects peculiar to small scale equipment. The system studied was benzene-toluene. The packing used was one inch Berl saddles.

A wide range of operating conditions was explored from low tower loading up to the flooding point. HETP values were determined and plotted as a function of gas rate, liquor rate, superficial gas velocity, percent of loading and percent of flooding. The data shows that in spite of increased demand on a column at higher through-puts, the separating efficiency improves at higher through-put with the best performance occurring in general between the loading point and flooding point.

Plotting of HETP as a function of a single variable such as liquid or gas rate resulted in only a fair correlation with appreciable deviation of data from the mean curve. Similar results were obtained for correlations as a function of percent of loading and percent of flooding. Data plotted as a function of gas rate at constant liquid rate correlated well. Plotting HETP as a function of liquid rate at constant gas rate also resulted in a good correlation. It is concluded that both of these variables must be taken into account when extrapolating design data.

Data show that at constant liquid rate values of HETP increase with increased gas rate over an initial range and then decrease with further increase of gas velocity. Indications are that HETP values increase during the initial range due to the increased molar transfer, a decrease in the effective wetted area of the packing and increased entrainment. Improvement in HETP values at the higher gas velocities is attributed to increased effective wetted area and decrease in drop-wise flow due to a spreading out of the liquid film. At the lower gas rates flow is not entirely film-wise and drop-lets break away from the surface of the packing and fall freely impinging on pieces of packing below in a cascading fashion giving rise to entrainment. As gas velocity increases the mechanical action of the gas impinging on the wetted packing spreads out the liquid over more of the packing surface. This increases the effective area of the packing and increases the ratio of film-wise to drop-wise flow.

The results obtained point out the significant effect of flow condition on packing efficiency and caution against any simplified extrapolation of HETP data in design work to conditions other than those for which it was obtained. Results also point out that packed columns are not particularly well suited to applications where wide ranges of production rate are encountered. When used under the latter conditions intermediate storage tanks should be

provided to accumulate crude feed for a distillation run under design conditions.

Microfilm $2.50; Xerox $7.20. 151 pages.

MECHANISM OF EXTRACTION OF THE RARE EARTH NITRATES BY TRIBUTYL PHOSPHATE

(L. C. Card No. Mic 59-5662)

Harry Edward Bostian, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Morton Smutz

The neodymium nitrate-tributyl phosphate-water system was studied in an effort to define the character of the neodymium nitrate-tributyl phosphate complex formed in the organic phase. Three different tributyl phosphates, tri-n-butyl phosphate, tri-iso-butyl phosphate, and tri-sec-butyl phosphate, were prepared. The preparation of tri-tert-butyl phosphate was unsuccessful and was concluded to be impossible because of steric hindrance.

Karl Fisher titrations indicated that the water equilibrated tributyl phosphate used as the solvent in the extraction studies had a mole ratio of water to tributyl phosphate of approximately one for commerical grade tributyl phosphate and the synthesized tributyl phosphates.

Infrared spectra of the organic phase were studied, using commercial grade tributyl phosphate with varying concentrations of neodymium nitrate and water. Equilibrium data were obtained for the system using the different tributyl phosphates, and material balances were made for each equilibrium point that was evaluated.

From the above studies, it was concluded that ion-dipole inter-molecular attractions or steric effects may be important in the formation of the complex because the extraction data with the different tributyl phosphates correlate with the degree of compactness of the various tributyl phosphate molecules. The infrared data showed that complexing between tributyl phosphate and neodymium nitrate takes place in the vicinity of the P=O bond of the tributyl phosphate molecule. It was also concluded from the above studies and preceding work by others that the reaction between the water equilibrated tributyl phosphate and the neodymium nitrate can be written as

$$Nd(NO_3)_3 + 3\ TBP\cdot H_2O \longrightarrow Nd(NO_3)_3\cdot 3\ TBP + 3\ H_2O$$

where TBP refers to tributyl phosphate. The only other component in the organic phase not accounted for by the reaction is the excess water equilibrated tributyl phosphate. This remaining water and tributyl phosphate must therefore be present in a mole ratio of approximately one to one.

Since the interactions involved in the complex may be weaker and more sensitive to temperature variations than usual bonds, the numbers assigned in the above equation should be accepted as approximations.

Microfilm $2.50; Xerox $6.20. 126 pages.

DESIGN, CONSTRUCTION, AND TESTING OF A SOLVENT EXTRACTION PILOT PLANT.

(L. C. Card No. Mic 59-5984)

James R. Cameron, Ph.D.
Case Institute of Technology, 1959

The extraction of phenol from a phenol-toluene mixture using water as a solvent was investigated at 90 °C., 70 °C., and 26 °C., under one atmosphere, in a 4" I.D. by 5' high spray column.

At 90 °C. and 1 atmosphere, an azeotrope of toluene and water boiled so vigorously that the raffinate layer became a froth and successful equipment operation ceased.

At 70 °C. and 1 atmosphere, no operational difficulties were encountered. Utilizing phenol concentrations up to 23.4% in the feed and varying the solvent to feed ratio from 2 to 20, gave phenol concentrations in the extract up to 2.8%. The use of extract reflux was considered for increasing the phenol concentrations in the extract, but was not applicable. The solvent was found to be the controlling phase. The relationship between the HTU_{os} and extraction factor, mS/F, which was developed is:

$$HTU_{os} = 1.173 + 2.43(mS/F).$$

The practical maximum percent phenol extractable at this temperature was about 94%.

At 26 °C. and 1 atmosphere no operational difficulties were encountered. The extraction was found to be more difficult at this temperature than at 70 °C. The practical maximum percent of phenol extractable was about 84% as against 94% realized at 70 °C. The relationship between HTU_{os} and extraction factor was found to be

$$HTU_{os} = 0.45 + 3.147(mS/F).$$

Microfilm $2.50; Xerox $4.80. 92 pages.

DI-CALCIUM PHOSPHATE BY DIRECT ACIDULATION OF PHOSPHATE ROCK

(L. C. Card No. Mic 59-5666)

Kuo Kang Feng, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: David R. Boylan

An investigation was undertaken to develop a process for producing di-calcium phosphate by direct acidulation of phosphate rock. In general, when phosphate rock is treated with sulfuric acid, mono-calcium phosphate or phosphoric acid is formed.

If less sulfuric acid is used, di-calcium phosphate should be formed theoretically, however only mono-calcium phosphate and undecomposed phosphate rock result in practice.

Both mono-calcium phosphate and di-calcium phosphate are effective plant foods, however di-calcium phosphate not only requires less sulfuric acid in manufacture but is also neutral and has good physical properties. As both temperature and concentration have an important effect on the formation of di-calcium phosphate, knowledge of the equilibria in the system CaO-P_2O_5-SO_3-H_2O was

required. This was determined in the laboratory at 100°C. and 145°C. Equilibria in the ternary system CaO-SO_3-H_2O was also investigated at 100°C. and 145°C. as well as in the ternary system CaO-P_2O_5-H_2O at 145°C.

The CaO-P_2O_5-SO_3-H_2O system is a four component system and a graphical representation proved rather difficult. However, for that part of the quaternary system which was of interest, a graphical method of representation was developed in two dimensions.

By using the phase relationships, a cyclic process for the manufacture of di-calcium phosphate was proposed.

This process consists of precipitating calcium with sulfuric acid, separating calcium sulfate, forming di-calcium phosphate by adding phosphate rock to the filtrate and final separation of di-calcium phosphates.

In laboratory scale work the optimum conditions were studied. A final acidulation mol ratio of 2.16 gave a maximum citrate soluble P_2O_5 content of 33.8 percent, equivalent to 94 percent P_2O_5 availability. In general high temperature curing had little effect on the P_2O_5 availability. The maximum product contained 94.6 percent P_2O_5 availability, 41.4 percent total P_2O_5, 33.8 percent citrate soluble P_2O_5 and 5.4 percent water soluble P_2O_5.

Pilot plant tests were made to demonstrate the process on a continuous basis. In the pilot plant calcium sulfate was separated by settling and di-calcium phosphate was not separated. Additional phosphate rock was added to the solution to form a solid product which was converted in paddle conveyers. The resulting acidulation ratio was 1.58 by weight instead of the 2.16 used in the laboratory.

Di-calcium phosphate was obtained in the pilot plant by this method without cyclic mixing or filtration. A product averaging 40 percent total P_2O_5, 33.2 percent citrate soluble P_2O_5 and 92 percent P_2O_5 availability was obtained.

A preliminary cost estimation indicated the proposed di-calcium phosphate process was favored.

Microfilm $2.50; Xerox $5.40. 108 pages.

A NEW METHOD OF MEASURING INDIVIDUAL FILM RESISTANCES IN DISTILLATION COLUMNS

(L. C. Card No. Mic 59-6634)

Dennis Donald Foley, Ph.D.
The Ohio State University, 1954

In order to avoid making some of the assumptions previously necessary in measuring individual resistance to mass transfer in distillation or absorption equipment, a new method was devised. This method depends upon the fact that by using an inert, noncondensible, gas whose molecular weight lies between those of the two components of a binary mixture a pair of gaseous mixtures can be made with matching densities and similar ratios of concentrations for the outside pair of components. The gas containing the third inert component, however, will have quite different properties regarding diffusion and viscosity. By the use of similar flow rates in terms of liquid quantities and the column F factor, $u\sqrt{\rho}$, pairs of runs can be made that are dynamically similar, but in which the properties of the films, respecting mass transfer, are quite different. These run pairs can be utilized in sets of four linear equations to solve for the individual film resistances. The four equations used consist of:

(1) Colburn's equation for the two-component run
(2) Colburn's equation for the three-component run
(3) Relationship between the liquid-film resistances for the pair of runs based on j factors
(4) Relationship between the gas-film resistances for the two cases based upon j factors.

By making such a series of calculations for a number of distillation runs with methanol-water and methanol-water-nitrogen, the following results were obtained.

1. By the use of a new method of separating the individual film transfer units, it has been shown that the individual film-transfer units in a plate column distillation are dependent upon the column F factor, $(u\sqrt{\rho})$; the actual volume of liquid flowing across the plates; the reflux reaction, (V/L); and the slope of the equilibrium curve. The F factor used in this work is defined as the product of the superficial vapor velocity times the square root of the density of the vapor flowing through the column; consequently, it is directly proportional to the square root of the kinetic energy of the gas stream.

2. By the use of the individual film-transfer units obtained using methanol-water, the P.T.U. values for a pair of ethanol-water distillations have been calculated. These results were compared to the result of a simple interpolation of the P.T.U. data for methanol-water and to the transfer units calculated directly from the run data. If the transfer units calculated from the run data are correct, the values obtained by using individual film-transfer units were 3.6 and 1.3 per cent in error, compared to the errors of 9.7 and 15.3 per cent obtained by the simple interpolation.

3. The equations developed by Lewis relating the local Murphree efficiencies, the Murphree plate efficiencies, and the number of transfer units have been evaluated by a series of calculations. By the use of the Murphree plate efficiencies obtained from the run data for methanol-water, the number of transfer units was calculated. This number of transfer units was compared with the number obtained by direct graphical integration of the data. The number of transfer units calculated from the plate efficiencies was found to be error by from 10 to 50 per cent. This error increased as the methanol concentration decreased.

Microfilm $2.75; Xerox $9.40. 209 pages.

Abstract published by special arrangement with The Ohio State University.

PHYSICAL PROPERTIES OF COTTON AS A FUNCTION OF PROCESSING

(L. C. Card No. Mic 59-5203)

Warren T. Milloway, Ph.D.
Princeton University, 1958

Recent work on cotton shows cellulose degradation as a result of mechanical processing. The physical properties of the cotton should also undergo changes since the physical properties of a polymer are known to depend on its degree of polymerization. The purpose of the work reported here was to identify these physical property

changes, to measure their magnitude before and after chemical processing, and to evaluate their effect on the final or end products.

Of main interest in this study were the mechanical processes incorporated into a normal cotton spinning process converting baled fiber into yarn: opening, picking, carding, drawing, roving, and spinning. Particular attention was paid to the picking process which had been reported elsewhere as the worst offender among the various mechanical operations. The effects of the chemical processes, scouring and bleaching, were studied in order to estimate whether the differences caused by mechanical processing would survive such treatments.

Physical tests were limited to stress-strain properties, dimensional properties (length and fineness), maturity, yarn spinning tests, and moisture regain tests. These particular properties were chosen because they gave the most insight into the effects of mechanical processing on the final products and the mechanisms involved. Wherever possible, ASTM standard testing methods were used; however, many of the tests currently practiced required refinement to provide the necessary speed, flexibility, and/or precision. In the field of fiber testing, the electrostatic vibroscope for measuring single fiber cross-sectional area was developed and improved; the Pressley-Instron fiber bundle strength test was developed with emphasis on variables influencing the test results, so that more effective bundle strength tests could be made.

The thesis proposed here is that changes incurred in both mechanical and chemical processing produce detectable effects upon the physical properties of fibers and yarns manufactured therefrom. These effects are entirely or partly retained through subsequent operations. The chemical and physical changes are not necessarily directly proportional to each other nor are the same physical property changes involved in fibers as in yarns. However, both forms of processing leave detectable marks which are identified and explained through coincident consideration of various properties of fibers and yarns.

The most important indication of physical damage resulting from mechanical processing of cotton is fiber breakage. This breakage appears to be much larger than generally reported. Previous workers used weight average fiber lengths which deemphasize the short length groups and give inaccurate estimates of fiber breakage; unbiased estimates are obtained only from number average lengths. This fiber damage, which is of course irreparable, is confirmed by spinning tests. These tests indicate that a non-recoverable loss in spinnability and yarn quality is present. The yarn quality loss cannot be overcome by scouring and bleaching.

The breakage of fibers by the picker is concluded to be selective in that porportionately more of the immature than of the mature fibers are broken. An increase in maturity of longer length groups and a decrease in maturity of the shorter length groups has been reported previously but the selectivity here reported has not been noted.

Other property changes studied and reported in this work are modulus, breaking strength, breaking elongation, and breaking energies for fibers and yarns, uncrimping energies for fibers, and spinnability and quality for yarns. The single fiber uncrimping energy is the most sensitive to mechanical processing of all the single fiber physical properties. Explanations for the reported property changes and comparisons with the results of previous workers are given. Correlations of fiber properties with cross-sectional areas are also presented.

Microfilm $2.50; Xerox $6.00. 124 pages.

ADSORPTION OF METHYL LINOLEATE ON SILICA GEL FROM n-HEPTANE SOLUTIONS

(L. C. Card No. Mic 59-5972)

William J. Munley, Jr., Ph.D.
Case Institute of Technology, 1959

The selective adsorption of methyl linoleate on silica gel from n-heptane solutions was studied at 30°C. The adsorption equilibrium and adsorption rates were measured. The rates were measured in both batch and fixed bed operation. The effects of silica gel particle size on equilibrium and on rates were also determined. The resistance to mass transfer in the solid adsorbent particles was found to be rate controlling. Three models of mass transfer into adsorbent particles were examined in the light of experimental results. These models were: (1). assumption of a solid "film" resistance – the solid "film" model, (2). assumption of diffusion into the solid with both linear concentration gradients and a constant diffusion coefficient – the rate constant model, and (3). assumption of diffusion into the solid with a constant diffusion coefficient – the solid diffusion model. The solid diffusion model agreed only fairly well with the experimental results, but this agreement was much better than for either of the other models. The results indicate that in future work the solid diffusion model should be modified by taking into account the variation of the diffusion coefficient with particle loading. Microfilm $2.50; Xerox $4.60. 89 pages.

AN INVESTIGATION OF NATURAL CIRCULATION VERTICAL TUBE REBOILER CAPACITY AND PERFORMANCE

(L. C. Card No. Mic 59-5473)

Bill Jordan Pope, Ph.D.
University of Washington, 1959

Chairman: R. W. Moulton

Natural circulation vertical tube reboilers and evaporators have inherent advantages of simplicity of construction, high coefficients of heat transfer, low power consumption and compactness. Though such equipment is in quite general use, a clear knowledge of heat transfer rates, fluid circulation rates and the relationship between them does not exist. Reboilers thought to be overdesigned on the basis of expected overall coefficients of heat transfer, have been able to reach only 50 per cent of design capacity due to the failure of circulation.

This work correlates the vapor producing capacity of an experimental reboiler in terms of the system geometry and fluid properties using 0.5-inch and 0.875-inch I.D. boiling tubes 48 inches long, and five different boiling fluids. The vapor producing capacity, which is directly related to the heat transfer rate, is correlated in terms of

three dimensionless groups as predicted by a theoretical equation derived from a mechanical energy balance.

A useful design chart was developed based upon this equation, the experimental results of this work, and results of previous investigators. A design method is proposed which will help insure adequate circulation in natural circulation vertical tube reboilers.

Microfilm $2.50; Xerox $5.20. 105 pages.

LIQUID MIXING ON BUBBLE TRAYS AND ITS EFFECT UPON TRAY EFFICIENCY

(L. C. Card No. Mic 59-5146)

Donald George Robinson, Ph.D.
University of Delaware, 1959

Supervisor: Jack A. Gerster

One of the important steps in the design of distillation and absorption columns is the determination of tray efficiency. This overall efficiency of a tray is a function of the point efficiency and the degree of mixing of the liquid on the tray. Several methods of characterizing the degree of mixing were investigated before adopting the eddy diffusion concept.

Eddy diffusion coefficients were measured by a steady state injection of a salt tracer into the froth, and measurement of the tracer concentration as a function of distance upstream of the injection point. By this procedure data were obtained on a 3 in. bubble cap and perforated plate trays, 14 in. wide by 31 in. long, over a wide range of liquid rates, vapor rates and weir heights. Fluid systems used were air-water, steam-hot water, and steam-hot water with carboxymethylcellulose.

Mixing rates were also measured on a perforated plate tray 9 in. wide by 36 in. long, by an unsteady state dye injection technique. Dye was added near one end of the tray, operating at zero liquid rate, and the time required for the dye to diffuse to the opposite end of the tray was measured. Water, kerosene, calcium chloride solution, and carboxymethylcellulose solution were used as liquids.

These data were compared with the results of other investigators who obtained mixing coefficients from measurements of residence time distribution functions, or values of point and overall efficiencies.

It was found that if the mixing rates measured by all four of these procedures were compared on the basis of the eddy diffusion model, the agreement was quite good. A correlation was developed expressing the eddy diffusion coefficient as a function of gas velocity, liquid rate, weir height, and cap size. The mixing rate was found to be independent of liquid density, viscosity and surface tension, over the range normally encountered.

Design procedures were then set up for calculating the relationship between point and overall efficiencies.

Microfilm $2.50; Xerox $7.20. 151 pages.

SOME LAMINAR FLAME PROPAGATION AND STRUCTURAL PROPERTIES DERIVED FROM GAS DYNAMICS DETERMINATIONS

(L. C. Card No. Mic 59-5147)

Dale Lambourne Salt, Ph.D.
University of Delaware, 1959

Supervisor: Kurt Wohl

The objective of this investigation was to contribute to the elucidation of the hydrocarbon-air combustion process by the determination and analysis of the temperature profile and of the burning velocity of selected laminar butane-air flames at atmospheric and reduced pressures. Because of the complexity of the chemical kinetic and transport processes involved, this important combustion system has not yet yielded to a completely theoretical analysis.

The motion of microscopic-sized glass spheres was recorded by high-speed stroboscopic photography as the spheres passed through laminar flame fronts at pressures ranging from 1-atm. to 0.0443-atm. The gas flow pattern was deduced from the particle behavior by particle inertia calculations.

Mass continuity calculations based on adjacent pairs of gas streamlines yielded the temperature profile of the gases relative to the flame front, a procedure which in effect uses the flame gases as their own constant pressure gas thermometer. Further analysis of the temperature profiles yielded approximate profiles of the volumetric rate of heat generation by chemical reaction. The results indicated that butane-air combustion is incomplete at the luminous zone, and that energy release continues at a substantial but declining rate over an extended region following the luminous zone.

The burning velocity of forty laminar flames of conical or meniscus shape was determined by the particle-track technique. For conical flames of 2.96 mole per cent butane composition (stoichiometric equals 3.13), the normal burning velocity over the range 1.0 to 0.050-atm. was proportional to the -0.252 power of the pressure. The pressure dependence of the normal burning velocity was related theoretically to the overall chemical reaction order. The effects upon the burning velocity of variations in fuel-air ratio, flame environment, burner size, and burner gas velocity also were investigated.

Microfilm $3.25; Xerox $11.00. 249 pages.

AN INVESTIGATION OF ALUMINA-CHROMIUM AND ALUMINA-CHROMIUM-MOLYBDENUM CERMETS FOR USE IN AIRCRAFT GAS TURBINES

(L. C. Card No. Mic 59-6655)

Thomas Smithberger Shevlin, Ph.D.
The Ohio State University, 1954

The widely accepted term, cermet, was proposed by the late A. L. Berger[1] as a useful word for describing aggregate composites of a ceramic and a metal phase. Cermet B consisting of 28 per cent Al_2O_3 and 72 per cent Cr, and cermet A consisting of 34 per cent Al_2O_3 and 66 per

cent 80Cr-20Mo alloy were studied with a view to providing a material for jet engine components which would permit higher operating temperatures than those now employed. The required properties were considered to be a high degree of thermal shock resistance, adequate high temperature strength, and adequate oxidation resistance.

The powdered alloy, 80Cr-20Mo, was formed by diffusion alloying and subsequent crushing and hammer milling. Batches were prepared by wet ball milling in steel mills using tungsten carbide slugs and methyl alcohol. Bodies were prepared from dry granulated batch material by direct hydrostatic pressing, or by steel die pressing followed by hydrostatic pressing. Specimens were made in the form of bars, rods, nozzle diaphragm blades, and flame holders.

All specimens were fired in hydrogen-atmosphere molybdenum resistance furnaces to maturing temperatures of 3050°F (1677°C) for cermet B, and 3150°F (1732°C) for cermet A. The atmosphere was slightly oxidizing with respect to Cr during the early stages of the firing cycle, but became reducing with respect to all oxides of Cr during the latter portion of the cycle. It was reducing with respect to the oxides of Mo throughout.

Table I contains a summary of properties of cermet A.

TABLE I

Physical Properties of Cermet A

Firing Shrinkage: 15 ± 1 per cent

Density: 5.84 g./cc.

Porosity: None detectable microscopically or by water boiling.

Breaking strength:

Temperature, °F	Modulus of Rupture, psi	Tensile, psi
75	87,640	53,000
1600	---	40,350
1800	58,000	28,500
2000	45,500	25,000
2200	45,500	18,600
2400	38,750	9,415

Stress rupture, 1000-hour life:

Temperature, °F	Tensile stress, psi
1800	19,000
2000	4,000

Modulus of elasticity: 45 x 10^6 psi.

Oxidation resistance: Excellent: 0.001 to 0.002 inch penetration in 1000 hours at 2000°F. No low temperature oxidation.

Thermal shock resistance: Excellent. Withstands 1000 cycles of simulated burner blowout from 1900°F in Wright Air Development Center test for nozzle diaphragm blades and 30 cycles (maximum used) in the National Bureau of Standards test for flame holders.

Thermal expansion: 5.35 x 10^{-6} in the range 75 to 2000°F.

Table II contains a summary of properties of cermet B.

TABLE II

Properties of Cermet B

Firing shrinkage: 15 ± 1 per cent

Density: 5.85 g./cc.

Porosity: None detectable microscopically or by water boiling

Breaking strength:

Temperature, °F	Modulus of Rupture, psi	Tensile, psi
75	80,500	38,920
1600	62,100	----
1800	61,800	23,530
3000	57,600	21,750
2200	52,500	18,900
2400	34,600	----

Stress rupture, 1000-hour life:

Temperature, °F	Tensile stress, psi
1800	19,000
2000	4,000

Modulus of elasticity: 47 x 10^6 psi

Oxidation resistance: Excellent: 0.001 inch penetration in 900 hours at 2000°F. No low temperature-oxidation.

Thermal shock resistance: Good compared to ceramics. Withstood 600 cycles of Wright Air Development Center test for nozzle diaphragm blades, and 30 cycles (maximum used) of National Bureau of Standards Test for flame holders.

Thermal expansion: 5.85 x 10^{-6} in the range 75 to 2400°F.

Related investigation was conducted with respect to stress rupture life variation of cermet B, thermal shock endurance variation in cermet B, and the thermal expansion of cermet A in comparison to that of its components.

In the related studies for cermet B it was indicated that best stress rupture life results when less than 6 per cent Cr_2O_3 is dissolved in Al_2O_3 during sintering. A cored effect, similar to the black coring defect observed in improperly fired heavy clay ceramics, was found in nozzle diaphragm blades, and was traced to excessive oxidation during the early part of the firing cycle. Its elimination is desirable for best thermal shock resistance, and the means of elimination were shown. In both of these investigations of cermet B bodies an unidentified intermetallic phase was found.

It was demonstrated that the thermal expansion of cermet A is lower than that of its components in the temperature range 75°F to 1400°F, and lower than that of the average for its components up to 2200°F. It was shown that this is not caused by Cr_2O_3 dissolved in Al_2O_3, but rather that it is a purely mechanical effect caused by mutual stress between the corundum and metal phases. The magnitude of the tesselated stresses was calculated approximately.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The conclusions reached are: (1) that either cermet has adequate oxidation resistance for service up to 2000°F and higher, (2) that either body is suited for high stress service of approximately 15,000 psi at 1800°F, (3) that either cermet is suited for moderate stress service at 2000°F and higher, (4) that either cermet has adequate thermal shock resistance for flame holder application, (5) that cermet A has adequate thermal shock resistance for nozzle diaphragm blade application while cermet B is marginal for this use, (6) that either cermet is suited to attachment to similar cermets containing less metal and more Al_2O_3 through the use of graded compositions, (7) that tesselated stresses in these cermets can lead to a lower thermal expansion of the cermet than of its components, and that the magnitude of these stresses can be approximated. Microfilm $2.50; Xerox $8.40. 181 pages.

1. Berger, A. L. "Ceramic and Cermet Materials for Use in Aircraft Gas Turbines," News Letter of The Ohio Ceramic Industries Association, March 26, 1948. (Presented in meeting in Columbus, Ohio, November 7, 1948.)

Abstract published by special arrangement with The Ohio State University.

INTERPHASE CONTACT IN LIQUID-LIQUID SPRAY COLUMNS

(L. C. Card No. Mic 59-5239)

Robert Edgar Coleman Weaver, Ph.D.
Princeton University, 1958

The degree of contact between two phases clearly affects the overall rate of any process occurring across the phase boundary. For most practical transfer operations, however, where one fluid is dispersed through the other, one has generally not been able to estimate the contact area except through a difficult direct measurement. The present work proposes an independent method of obtaining this estimate for the liquid-liquid spray column—along with substantiating experimental evidence.

The laboratory observations were made on a series of four liquid-liquid pairs felt to be representative of the systems of liquid-extraction interest. No motion of the continuous phase was involved in the present experimental work, but the proposed method is suggested to be applicable to the more practical situation where both phases are in flow. Use of the slip velocity, the relative velocity between the two phases, as the unique flow variable, is the basic feature of this extension; such a procedure has been shown to be valid for analogous solids-dispersed systems.

Specifically, the "holdup", i.e. the volume fraction of the dispersed phase in the operating spray column, is the convenient measure of the interphase contact in the column. This holdup is related to a "slip velocity ratio".... the ratio of the slip velocity in the column to the terminal velocity of a representative single droplet. This relationship was shown to approach that exhibited in earlier solids fluidization studies by rigid particles of the same size and density.

Drawing upon these fluidization results, and upon supplementary information for the single droplet terminal velocity, the present work has indicated how one can obtain a design estimate of the holdup in the liquid-liquid spray column without recourse to experiment.

Microfilm $2.50; Xerox $5.60. 115 pages.

EXTRACTION, PURIFICATION, AND PROCESSING OF CRUDE LACTIC ACID SOLUTIONS.

(L. C. Card No. Mic 59-6645)

Robert Bruce Weiser, Ph.D.
The Ohio State University, 1954

Lactic acid is potentially an important industrial chemical. However, its uses are somewhat limited at present because difficulty in purifying it has made it relatively high priced. The present investigation was carried out to thoroughly study liquid-liquid extraction as a method of purification, as well as to study the further processing problems involved.

The first series of tests were made to determine the distribution data for pure lactic acid between water and a large number of organic solvents. The effects of elevated temperature and various additives upon the distribution were also determined with many of the better solvents from the original tests. The distribution of the impurities of the crude solution were then determined with the better solvents and conditions of the previous tests. Distribution runs were then carried out with the crude solution and the better solvents.

The alcohols were found to be the best series of compounds for the extraction of lactic acid. The distribution was found to become slightly more favorable by increasing the temperature. However, the increase was not sufficient to warrant the use of elevated temperatures. The use of additives increased the distribution by as much as 50 per cent, but the savings were not sufficient to compensate for the increased handling and raw material costs.

The original solvent search also indicated that by a log-log plot of the distribution ratio versus the molecular weight of the solvent limited data can be extended since a straight line relationship results.

The four and five carbon alcohols showed the best combination of favorable distribution, physical properties, and cost. However, the five carbon alcohols, particularly iso-amyl alcohol, extracted considerably smaller amounts of the sugars, the most troublesome impurity. Consequently, iso-amyl alcohol was chosen as the solvent for the preliminary process evaluation.

For the purpose of a cost estimate on the process, a ternary diagram and complete density data were determined for the lactic acid-water-iso-amyl alcohol system. Steam distillation was also investigated as a possible method of separating the lactic acid from the solvent.

On the basis of this experimental data a preliminary process design and economic evaluation was made. This indicated that at the current selling price of the pure lactic acid an approximate net profit of 68 per cent is possible, and the payout time is 1.13 years. Therefore, the purification process developed in this investigation has definite commercial possibilities. Microfilm $2.50; Xerox $7.00. 146 pages.

Abstract published by special arrangement with The Ohio State University.

AN ENGINEERING STUDY OF THE EFFLUENT DISPOSAL PROBLEMS OF THE LOUISIANA RAW SUGAR INDUSTRY

(L. C. Card No. Mic 59-5531)

Joseph Edward Wheeler, Jr., Ph.D.
Louisiana State University, 1959

Supervisor: Professor Arthur G. Keller

Cane sugar manufacture is Louisiana's oldest industry, dating back to 1750. The cane grinding operation is seasonal, starting in mid-October and lasting about 70 days depending upon the crop and weather.

Cane juice, molasses, and sugar, because they are readily utilized by most biological organisms as food, are strong sources of organic pollution. Sugar and molasses have Biochemical Oxygen Demands of 1,250,000 and 930,000 ppm, respectively.

Although the method of processing sugar cane into sugar is the same as it has been for many years, changes in drainage patterns and factors have brought pollution problems created by the sugar industry into focus.

With the influx of other industries in the sugar area the populace which formerly accepted pollution resulting from sugar processing as a necessary burden, is now striving to keep the waters suitable for recreation.

The average throughput of Louisiana raw sugar factories has increased over the years as a result of low sugar prices and rising costs. Many factories now handle twice the amount of cane for which they were originally designed. This overloading has increased pollution of the streams because of spills and/or entrainment in evaporators and vacuum pans.

Mechanized methods of cane harvesting have increased the amount of field mud delivered with the cane so much that over half of the mills now are obliged to wash it prior to processing. The effluent from the washing operation is heavily laden with sugars, soil, and pieces of broken cane.

Plant effluent surveys, made by the author, showed that the principal effluents not readily controlled by efficient factory operation are the cooling water from the barometric condensers and cane wash effluent. Factories were losing substantial quantities of sugar per day through entrainment. This problem was remedied by revising the entrainment removal devices on the evaporators and vacuum pans.

A study was then made of the cane wash effluent problem in order to effect a reduction in effluent volume while maintaining effective dirt removal from the cane and to develop an economical treatment.

It was shown that the volume could be reduced to one-third by multi-stage washing without danger to the factory from biological growths. Batch reactors were utilized to evaluate the effects of aeration, temperature, and nutrient addition on the bio-stabilization of cane wash effluent.

Aerobic operation was found to be several fold faster than anaerobic. The effect of temperature was found to closely follow the van't Hoff-Arrhenius relation, i.e., the rate approximately doubled for each 10°C increase in temperature. An analysis of variance showed that nitrogen addition in the ratio of about 1:20 nitrogen to B.O.D. was optimum for rapid stabilization. Potassium and phosphorous had no significant effects.

Microfilm $2.50; Xerox $7.00. 150 pages.

RESPONSE OF A LIQUID-GAS INTERFACE TO CONCENTRATION FLUCTUATIONS

(L. C. Card No. Mic 59-5149)

Stephen Whitaker, Ph.D.
University of Delaware, 1959

Supervisor: Jack A. Gerster

Frequency response techniques have been applied to the study of the absorption of sulfur dioxide in water. The liquid studied was both "old" and contaminated with surface active materials. The response of a liquid film 0.004 inches thick to a sinusoidally varying sulfur dioxide pressure was determined for frequencies from one to ten cycles per second. The pressure over the liquid film and the average concentration in the liquid film were measured continuously and recorded with an oscillograph. The average liquid concentration was observed by measuring the amount of light absorbed by the film, which contained a colored hydrogen ion indicator.

The experimental data indicate the presence of a surface phase of adsorbed material through which the sulfur dioxide must pass as it is absorbed and desorbed. The mass transfer rates from this surface phase to and from the gas and liquid are very dependent on temperature and on the excess surface concentration of the hydrogen ion indicator, Cresol Red, which was positively absorbed on the surface. Microfilm $2.50; Xerox $7.00. 148 pages.

SOME FACTORS AFFECTING THE SINTERING PROPERTIES OF KYANITE

(L. C. Card No. Mic 59-6658)

Hugh Hayes Wilson, Jr., Ph.D.
The Ohio State University, 1954

Kyanite is an aluminum silicate with the formula $Al_2O_3 \cdot SiO_2$. It is one of the sillimanite group of minerals which includes sillimanite and andalusite. These three minerals have the same chemical formula but different crystallographic and thermal properties. There are two additional minerals that are usually included in this group; topaz, which contains fluorine and hydroxyl ions, and dumortierite, which contains boric oxide. The properties of this family of minerals are given in Table I.

Kyanite that is used in the ceramic industry is either imported from India or mined in the United States. At the present there are two deposits being mined in America, one in Virginia and one in South Carolina. (The material investigated and reported in the dissertation was from the South Carolina mine of Commercialores, Inc.) The kyanite occurs in a quartz schist and is associated with pyrite, sericite, quartz, and ilmenite. A chemical analyses of the refined kyanite is as follows (analysis by chemical laboratory of Engineering Experiment Station, The Ohio State University):

SiO_2	43.11%
Al_2O_3	53.09
TiO_2	0.87
CaO	0.10

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MgO	Trace
Na_2O	0.40
K_2O	0.24
Fe_2O_3	1.48

One of the more important differences in Indian and domestic kyanites is the fact that Indian kyanite does not show a large volume expansion on heating. Domestic kyanite, on the other hand, expands upon undergoing the transformation to mullite. This transformation takes place at about 2500°F., but the actual temperature may be higher or lower depending on the grain size of the material, the rate of heating, and the presence of other materials which may act as mineralizers. The amount of expansion also varies with the grain size of the kyanite. Work done in this investigation has shown that compacts heated to 2800°F. show a linear expansion ranging from about 12 per cent to two per cent when using 35 mesh and 200 mesh kyanite, respectively.

The fact that domestic kyanite is finely dispersed in the schist makes it impossible to produce a grain size larger than 35 mesh. For use in refractory products it is often desirable and advantageous to use a grog as large as four mesh or larger. This investigation was therefore undertaken to develop a suitable grog from kyanite.

TABLE I

PROPERTIES OF SOME HIGH-ALUMINA MINERALS

Mineral	Specific Gravity	Decomposition Temperature	Al_2O_3/SiO_2
Kyanite	3.53-3.67	1100°-1480°C.	1.72
Andalusite	3.13-3.20	1350°-1450°C.	1.72
Sillimanite	3.23-3.24	1550°-1650°C.	1.72
Dumortierite	3.22-3.43	1000°-1250°C.	2.25
Topaz	3.40-3.60	1000°-1480°C.	2.33-2.46
Mullite	3.156	stable to 1810°C.	2.55

Whereas Indian kyanite remains dense and hard after calcination, domestic kyanite becomes quite friable. Therefore, even infrequently occurring coarse-grained raw kyanite will not produce a suitable fired grog. For this reason, an artifically prepared grog is the only answer to the problem, and it was felt that such a grog could be produced by sintering the kyanite into a mass having low porosity. Such a process would involve the investigation of the effect of particle size, forming pressure, firing temperature, and use of mineralizers. These variables were investigated within limits, and the results are given in the report.

With the objective in mind of obtaining a dense mullite grog having a low porosity, it is apparent that several methods could be used to arrive at such an end. As several companies have done, the kyanite could be fused at high temperatures to form a glass which devitrifies on cooling to mullite and either glass or corundum depending on the alumina-silica ratio. Such a process would require heating the material to approximately 3200°F. at the least and probably higher. An alternative method would involve the addition of sufficient fluxing material to obtain the same result at a lower temperature. The firing temperature would be lowered in proportion to the amount of flux used, but the pyrometric cone equivalent (P.C.E.) of the resulting grog would likewise be lowered. In addition, both methods would most probably produce a grog containing large mullite crystals, which is undesirable from a strength standpoint. It was therefore decided to investigate the sintering properties of kyanite as a basis for grog preparation.

From the literature survey it became apparent that the kyanite would have to be ground finer than 200 mesh, for it has been determined that the sintering rate increased with fineness of grind. Also, the volume expansion exhibited by kyanite on decomposing to mullite is proportional to the grain size, and a large volume expansion can not be tolerated either from the standpoint of disruption of the fired bond or the mechanical process of rendering the body more porous. The effect of grain size was investigated by using the commercially available 200 mesh material and also 200 mesh kyanite ground for various lengths of time.

Fluorides were chosen as additives for two reasons. First, the fluorine in topaz is thought to be beneficial in promoting bonding and mullitization. Second, fluorine is known to reduce the viscosity of glasses at high temperatures. If the viscosity of an interstitial glass were reduced, it could better distribute itself throughout the body and produce a more tightly bonded structure. Boric oxide was added because it is a constituent in dumortierite, another mineral which decomposes at relatively low temperatures to yield mullite.

In addition to the use of mineralizers and the effect of grain size, forming pressure, firing temperature and time of soak at temperature were varied and their effects studied. Forming pressures from 5,000 to 20,000 pounds per square inch were used. Pressures up to 10,000 pounds per square inch are used commercially for shapes as large as nine by four and one-half inch brick, and pressures as high as 20,000 pounds per square inch would not be impractical for smaller shapes such as the specimens used in the present investigation.

The firing temperature was varied from 2650°F. to 2850°F. Previous work has shown that a firing temperature of at least 2750°F. is necessary to remove the volume expansion caused by mullitization of the kyanite and to obtain maximum fired strength. Soaking periods of two, four, and eight hours at maximum temperature were used. It was felt that an eight hour soak was sufficient for the reactions to take place and that longer times were impractical at the relatively high firing temperatures employed.

Results of the investigation are as follows:

1. The degree of sintering of raw kyanite and calcined kyanite is practically the same for equal grain-size distributions when the specimens are formed and fired under the same conditions.

2. The degree of sintering of kyanite increases with: (A) decreasing grain size, (B) increasing forming pressure, (C) increasing firing temperature, (D) increasing length of soak at the firing temperature.

3. It is necessary to grind raw kyanite to a grain size of approximately 325 mesh to obtain dense pieces on firing to 2800°F. This is necessary because 200 mesh or larger kyanite expands on heating.

4. Five per cent of topaz is an excellent mineralizer for kyanite.

5. One per cent of calcium fluoride or one-half of one per cent of magnesium fluoride act as mineralizers for kyanite without lowering the P.C.E. over one-half cone.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

6. Aluminum fluoride appeared to be inactive in the sintering process and was neither an aid nor a hindrance in promoting sintering in kyanite.

7. Boric oxide was detrimental to the sintering of kyanite. A three per cent addition of boric oxide was more destructive than a one per cent addition.

8. The fired strengths of the kyanite pieces were high and a grog made in the manner in which these pieces were made would have excellent strength properties for use in refractory products.

9. A wide range of fired properties can be obtained by varying one or more of the factors influencing sintering. Thus, a grog could be produced which has good mechanical strength and an absorption ranging from about 12 per cent to zero.

10. Kyanite is a potent addition to a ceramic body that must meet an accurate degree of volume constancy if the ware is treated in line with the three variables cited in the thesis. Microfilm $2.50; Xerox $5.00. 98 pages.

Abstract published by special arrangement with The Ohio State University.

COMPUTATION OF CHEMICAL EQUILIBRIA IN COMPLEX MIXTURES

(L. C. Card No. Mic 59-5977)

Frank J. Zeleznik, Ph.D.
Case Institute of Technology, 1959

A computer program for chemical equilibrium calculations has been developed. It has been written for the IBM 650 computer with 2000 words of drum storage, 60 words of core storage, indexing registers and floating point attachments. The program is capable of carrying out combustion and isentropic expansion calculations on a chemical system which may include as many as ten different chemical elements if no condensed phases appear as reaction products. However, when condensed phases are considered the sum of different chemical elements and different condensed phases must not exceed ten.

With these restrictions the program will handle as many as thirty reaction products, and twenty-five expansion ratios. In addition to the equilibrium composition, temperature and pressure the program calculates other parameters including heat capacity, isentropic exponent, two molecular weight derivatives, and some rocket performance parameters.

Microfilm $2.50; Xerox $6.00. 124 pages.

ENGINEERING, CIVIL

THEORY OF DOUBLY CURVED SHELLS

(L. C. Card No. Mic 59-6491)

Avinoam Libai, Ph.D.
Purdue University, 1959

Major Professor: John E. Goldberg

In this thesis, the basic equations of the linear bending theory of arbitrary shells in arbitrary parametric representation are derived. These equations are then reduced to either three partial differential equations in the components of the displacement vector or to four second-order partial differential equations in four invariant unknowns - three of which are stress resultant invariants and the fourth being the normal displacement.

The latter representation has the advantage of convenience in numerical computations since each of the equations includes only two of the unknowns.

The method used in obtaining the equations employs extensively the "changes" in the various shell functions as characterizing the deformation. The background of all of the derivations is vector differential geometry of surfaces.

The procedure used in deriving the equations is as follows: First, the relations between the changes, also termed "deformation components," and the displacements are derived. The relations between the stress resultants and the deformation components are then derived through the use of the Complementary Energy Principle and integration through the shell thickness. This is followed by a derivation of the equilibrium equations. Substitution of the stress-deformation relations leads to the equilibrium equations in terms of deformations.

Alternatively, an approximate "compatibility" equation linking the dilatation with the normal displacement is derived. This is followed by a simple expression connecting the transverse shears with the normal displacements. These two derivations permit the writing of the basic equations in terms of the force resultants and normal displacement only.

The more convenient form of the last equations enables the formulation of a finite-difference matrix method for obtaining numerical results in many important cases. An analysis of the resulting expressions shows that when the Gaussian Curvature of the median surface is negative, the membrane state of stress may be not valid even at points far from the boundaries or singularities.

The general discussion is followed by a detailed analysis and a numerical example for a hyperbolic paraboloidical shell resting on asymptotic lines as boundaries.

Microfilm $2.50; Xerox $7.20. 154 pages.

DESIGN OF A PRESSURE SENSITIVE CELL AND MODEL STUDIES OF PRESSURES IN THE SUBGRADE OF A FLEXIBLE PAVEMENT SYSTEM

(L. C. Card No. Mic 59-6497)

Thurmul Francis Mc Mahon, Ph.D.
Purdue University, 1959

Major Professor: Eldon J. Yoder

This thesis reports the design and development of a pressure sensitive cell and the use of this cell in making pressure measurements in homogeneous and two-layer model pavement systems.

The pressure cell is of the diaphram type, one and one-half inches in diameter and three eighths of an inch thick. SR-4 Strain Gages are used to measure the deflection of the diaphram as pressure is applied to the cell. A study was made of the action of the cell in clay-soil and in sand media, as compared to its performance during calibration under air pressure. It was determined that the performance in the clay-soil was very similar to that in air, but that in sand the cell behavior was erratic.

Pressures were measured under three different size plates, on a homogeneous compacted clay fill, and on the same fill when varying thicknesses of the upper portion of the clay had been replaced with a compacted crushed limestone base. These measured pressures have been compared with the theoretical pressures, as determined by the Boussinesq and the Burmister Methods. They have also been compared with pressure measurements made by the Corps of Engineers, at their Waterways Experiment Station. A fair correlation of measured and theoretical pressures has been made by using a modification of the Boussinesq method, called the Equivalent Plate Method. However, it is necessary to have the magnitude of the interface pressure to establish this correlation.

The following are some of the conclusions that have been made during this study:

1. The pressure cell, which was designed and developed as part of the project, measured the pressures within the subgrade with an accuracy which should make it a very helpful tool in furthering knowledge of pressure distributions.
2. The stress distribution within a homogeneous soil mass, under a semi-rigid plate, is similar to the Boussinesq pattern of distribution for a uniformly loaded area.
3. The stress distribution within a homogeneous soil mass is affected but very little by a considerable change in strength of the mass.
4. The stress distribution in a two-layer system depends to a large extent upon the strength and thickness of the upper layer.

Microfilm $2.50; Xerox $8.60. 188 pages.

LIMIT DESIGN OF MULTISTORY STRUCTURES

(L. C. Card No. Mic 59-6109)

Donald Albert Sawyer, Ph.D.
The University of Florida, 1959

The problem of the limit design of multistory structures was investigated and a simplified procedure for the direct design of such structures is presented. In essence, the method consists of a preliminary design of the girder system considered as a continuous beam on simple supports. The preliminary girder system is later strengthened to account for additional moments that are caused by horizontal shear forces on the structure. The columns are designed for the combined effects of axial load and moment by the simple plastic theory. Recommendations for the treatment of column instability are included.

The problem of minimum weight was investigated and certain simple rules that permit the direct minimum-weight design of complex or multistory structures are advanced. In general, it was found that due to the nonlinear relationship between the unit weight of a structural member and its plastic moment, the minimum weight would be approached if the greatest strength were assigned to as few members as possible. Deflection and other practical considerations limit the extension of the rules to their natural conclusion. Deviation from the rules, for practical reasons, is advised where applicable, and examples are given to illustrate this influence upon the weight of typical regular and irregular structures.

Microfilm $3.40; Xerox $11.60. 262 pages.

A LABORATORY INVESTIGATION OF THE PHENOMENON OF FRICTION AS APPLIED TO FINE-TEXTURED BITUMINOUS PAVING MIXTURES

(L. C. Card No. Mic 59-6519)

Jack Edward Stephens, Ph.D.
Purdue University, 1959

Major Professor: William H. Goetz

This presentation recognizes that the friction generated between a skidding rubber tire and a bituminous pavement must be attributed to several causes. In order to better understand friction, and as a start toward the eventual goal of predicting the potential frictional resistance of a pavement before it is built, an effort was made to evaluate each of the causes and to establish their relative importance. An explanation of friction is presented as it applies to the slippage between a rubber tire and a pavement surface.

An extensive series of studies was carried out by preparing specimens from sand mixes of widely varying gradation and testing the resulting surfaces for skid resistance in the machine developed earlier at Purdue University. As a result of these tests, estimates of the size of roughness or surface texture contributing most to skid resistance were made. The optimum height of roughness for maximum skid resistance was estimated as .009 inches at a spacing of 0.018 inches for crushed silica sand. For

rounded sands, indications are that the optimum height is less than that for the crushed material. The series of tests on effect of gradation show the possibility of creating surfaces of improved skid resistance by controlled gradation of the aggregate. For mixtures of different gradations using Lafayette sand of sizes smaller than a No. 4 sieve, the minimum skid resistance recorded after two polish cycles was 45 and the maximum 81. This large variation in skid resistance caused by gradation of the sand could be of great significance in controlling skid resistance of pavement mixtures. Other gradation series based on smaller maximum size Lafayette sand gave changes of similar magnitude.

For economic reasons, a readily available mineral is usually used for aggregate in bituminous mixtures. As a result, the aggregate mineral character is subject to change with locality. In most of the field trials for comparing the effect of aggregates, the change in mineral aggregate used has been accompanied by other changes such as a variation in the gradation of the aggregate. In this laboratory study, the actual effect of the ratio of silica to carbonates was investigated by making mixes of the same gradation and particle shape but with different ratios of silica to carbonates. A range of silica content from five to ninety-eight percent was attained. As the silica content increased, the skid resistance increased at a variable and generally decreasing rate.

Past work has indicated that the aggregate shape has little effect on the skid resistance of coarse-textured bituminous pavements. Effect of shape of sand grains was investigated by comparing naturally rounded sand to material made by crushing coarse material from the same source. The grain sizes for successive mixtures were decreased until the resulting surface roughness of the mix was of the magnitude of that of the aggregate itself. The rapid polish or wear of hard, fine angular silica as compared to the rate of polish of the same material when rounded is pointed out.

In order to explain partially the variation of skid resistance with aggregate gradation, studies were made on stone cores treated in such a manner as to give varying combinations of surface area of aggregate and length of aggregate edges. Comparisons of results from these specimens were made and some degree of evaluation of the ratio of edges to surface determined. In the range of coarse aggregate sizes, little advantage was gained by increasing either the total length or the sharpness of the edges. However, a large change was found in the relative resistance values when the ratio of the area of aggregate to the total surface area was changed.

Throughout this study the factors of surface area and texture of the aggregate exposed in the pavement appeared to be dominant in the determination of skid resistance. For this reason a study was made of the correlation between skid resistance measured by the laboratory skid machine and the roughness measured by a Brush Surface Analyzer. The results obtained by means of the Surface Analyzer were not entirely satisfactory. However, sufficient visual correlation appears to exist to justify further attempts to evaluate skid resistance by surface measurements.

From this investigation into the skid resistance of fine bituminous mixes, the more important variables appear to be gradation and mineral composition of the aggregate. Varying either of these two factors caused large changes in relative resistance values. The relative resistance values increased as the aggregate gradations were made finer. Increases in the silica content of the aggregate caused the relative resistance values to increase. The magnitude of the changes in skid resistance caused by variations in silica content is closely related to fineness modulus or gradation of the aggregate. At low fineness moduli the increase in relative resistance value with silica content is large. However, for sands of coarser gradations in the range of fineness moduli of 3.5 to 5.5, silica content has a limited effect upon relative resistance values. The area of aggregate exposed in the surface tested is also of importance. The effects caused by adjusting gradation probably include this factor.

Microfilm $2.50; Xerox $7.80. 166 pages.

ENGINEERING, ELECTRICAL

A STATISTICAL MODEL OF ATMOSPHERIC NOISE

(L. C. Card No. Mic 59-6087)

John Marshall Barney, Ph.D.
The University of Florida, 1954

An analytical expression for the amplitude density function of atmospheric noise is developed, making use of two particular types of time functions. The fundamental approach used has been to start with the most general case, a nonstationary random process, and develop the density functions for such a process. The development used here follows that of Rice and Middleton although carried out in more detail. The restraint introduced by a stationary process results in a simplification of the general equations. A further restriction is made concerning the independence of events and the expressions to be used for the atmospheric noise model evolved. The time function of the individual noise waves appears explicitly in these expressions but the character of this time function has not yet been defined.

As a particular case an exponential and a triangular time function are chosen and the resulting expressions evaluated wherever possible. These expressions can be evaluated only under certain limited conditions, so that other methods must be found to solve these equations.

An approximate solution is obtained by means of a power series expansion and the validity of the results is discussed.

Finally a different approach to the solution of the resulting equations is suggested and a method of applying this procedure is outlined.

Microfilm $2.50; Xerox $4.80. 93 pages.

THE BALANCED MODULATOR AS A CROSSCORRELATOR FOR GAUSSIAN RANDOM SIGNALS

(L. C. Card No. Mic 59-6468)

William Philip Birkemeier, Ph.D.
Purdue University, 1959

Major Professor: George R. Cooper

A method is described for finding the crosscorrelation function of two jointly gaussian signals by use of the balanced modulator.

Crosscorrelation is defined, and applications to the detection of periodic signals in noise, detection of random signals in noise, and measurement of system impluse response are discussed. The signal-to-noise ratio for the output of a crosscorrelator is then defined as the ratio of the d-c power to the noise power in the output, and is used to indicate the quality of performance of a crosscorrelator throughout the remaining work. The signal-to-noise ratio for a pure-multiplier crosscorrelator is next calculated. The square-law multiplier and the related balanced modulator are discussed as possible crosscorrelation devices.

The transform method of analysis of gaussian noise through nonlinear devices on which the analysis of the balanced modulator crosscorrelator is based, is outlined and is applied to several familiar problems including extreme clipping and vth law half-wave rectification. Proof of the crosscorrelation property for the balanced modulator using half-wave and full-wave vth law nonlinearities is included next, and is followed by the calculation of the signal-to-noise ratios for each type device. It is shown that the full-wave balanced modulator provides a signal-to-noise ratio equal to the pure multiplier for any v if one input signal is made large compared to the other. Under the same conditions, the half-wave balanced modulator signal-to-noise ratio is shown to be considerably less, and to decrease with the mean-square value of the larger signal. These results are then applied to the case of impulse-response measurement and random signal detection.

Finally, the crosscorrelation property is shown to hold for the balanced modulator, using any nonlinearities that are expressible as a power series. From this we deduce that the even vth law nonlinearity provides the best signal-to-noise ratio possible which is equal to that of the pure multiplier. Microfilm $2.50; Xerox $4.80. 95 pages.

THE LINEAR GRAPH IN SYSTEM ANALYSIS

(L. C. Card No. Mic 59-5953)

William Allen Blackwell, Ph.D.
Michigan State University, 1958

Major Professor: Herman E. Koenig

None of the common system-analysis techniques are completely satisfactory for the analysis of mixed systems in general. Electromechanical analogies have been used with considerable success, but for complicated systems made up of multiterminal components, a more powerful formulation technique is needed.

In recent years, electrical network theory, using the notions of linear graph theory (studied formally under the mathematical designation of topology) has made significant advances in formulation techniques. In electrical network analysis, it has been found that networks, for which equations are virtually impossible to formulate using the conventional from-the-diagram node and mesh techniques, can be treated—using a systematic and simple procedure—by distinguishing between the equations characteristic of the components and those characteristic of the component connection pattern. The equations, which are characteristic of the connection pattern, are called circuit and segregate equations, and are written from a collection of oriented line segments, called a linear graph of the system.

The linear graph is useful in the analysis of any system in which one set of measurements sums to zero around closed circuits, and/or one set of measurements at points, areas or regions, sums to zero. With a proper understanding of its role in the analysis of systems, the linear graph can be obtained for a particular system by an orderly, logical procedure.

The general pattern of formulation of equations, used in electrical network theory, can be extended to the analysis of mixed systems if mathematical forms, different from those encountered in formal electrical network theory, are admitted for the equations characteristic of the components. When these mathematical forms are used, questions relative to rank of equations arise in a manner not treated in electrical network theory.

The problem considered is defined in Chapter I. In Chapter II convenient terms are defined, and the background is set, with respect to terminology and concepts, for consideration of the system formulation problem.

In Chapter III an examination is made of the conditions on topological placement of the various component types considered, such that a unique solution to the system equations is possible.

A set of general procedures for the systematic reduction of equations to be solved simultaneously is presented in Chapter IV. In all cases, the equation-reduction procedures do not involve taking a matrix inverse—depending instead upon explicit forms of equations.

A set of procedures for systems containing specific component types is given in Chapters V and VI. The number of equations to be solved simultaneously for each situation is noted. In many of these procedures, the number of equations to be solved as a simultaneous set—under certain topological arrangements of particular components—is less than would be the case with conventional mesh or node formulation.

Microfilm $2.50; Xerox $4.80. 93 pages.

A MODEL FOR HUMAN TRACKING BEHAVIOR IN A CLOSED-LOOP CONTROL SYSTEM

(L. C. Card No. Mic 59-6635)

Arthur Burr Fontaine, Ph.D.
The Ohio State University, 1954

The extensive development of complex, closed-loop control systems such as airplanes, certain radars, and

gun fire-control systems to the point of nearly automatic operation in the last few years has caused a greater emphasis to be placed on the data regarding capabilities of the human in such systems. Specific knowledge of the characteristics of the human while in a closed-loop control situation would be of considerable value in the design of such machines. One aspect of the investigation of human behavior in a control system has been to express the visual-input, motor-response characteristics of the human.

One means of expressing the visual-input, motor-response characteristics of the human is to obtain a transfer function of the human. There are two techniques which may be used in ascertaining an expression for the human transfer function. One approach is to measure experimentally the transfer function, using methods of electrical engineering.[1,2] Although an expression for the transfer function is obtained in this manner, the resulting transfer function is valid only for a particular set of experimental conditions, and little prediction can be made of how the transfer function would change under different experimental conditions. A second method of obtaining a transfer function of the human is to deduce the factors affecting human performance by a priori reasoning and then to combine these factors to match existing experimental data.[3] This second method was the approach used in the dissertation. A model of the human was formed by a suitable combination of the factors affecting human performance; the resultant transfer function was set up on an analog computer and the performance of the model was compared with the performance of the human.

The particular control system which is analyzed is a tracking situation in which the human receives visual information from the display on a cathode ray oscilloscope. The display consists of two vertical lines called the target and cursor, which move horizontally across the face of the cathode ray tube. The human's task is to keep the target and cursor superimposed by proper manipulation of a lever or arm control which is pivoted at one end and rotates only in the horizontal plane. The position of the cursor is directly proportional to the angular position of the arm control.

Two types of display are considered: (1) pursuit display, in which both the target and cursor move across the face of the cathode ray tube; and (2) compensatory display, in which the target remains stationary at the center of the cathode ray tube and the cursor is displaced by an amount proportional to the error.

Two types of problem signals were considered. The first problem signal was a 30 c.p.m. sine wave. The second was a random wave which had a Gaussian amplitude distribution and a spectral density peaked at 30 c.p.m. Skilled operators tracked these two problem signals using pursuit and compensatory displays and several combinations of display and manual control sensitivities.

The psychological factors which were assumed to be present in the visual-input, motor-response loop of the human and which were incorporated in the model are:

1. Dead-time lag. — In tracking studies in which the motion of the visual stimulus is unpredictable, a finite time elapses between the presentation of a visual stimulus and the beginning of a motor response. This type of time lag is referred to as dead-time lag.

2. Dead-time predictor. — In some motor-skill tasks, such as sine wave tracking in which the behavior of the visual stimulus is of a more predictable nature, the dead-time lag phenomenon is not apparent in the graphic recordings of the visual stimulus and motor response signals. One means of compensating for the dead-time lag is to predict the future status of the visual stimulus and to use the predicted status of the visual stimulus to execute the motor response.

3. Proprioceptive feedback. — In addition to the human obtaining visual feedback of the results of his arm movements, he may also obtain feedback through the arm in the form of proprioceptive feedback. With a sine wave problem the pattern, the amplitude and frequency, of the required arm motion is soon learned by the human. Once the required cyclic motion of the arm is established, the human may use proprioceptive cues such as position and velocity of the arm obtained from the feel of the control in making his motor responses.

4. Gain constant. — The magnitude of the motor response is related to the magnitude of the visual stimulus by a gain constant.

5. Noise. — To account for the randomness in the graphic recordings in the error and arm control signals of the human, two noise signals are introduced into the model. One of the noise sources is used to simulate errors which the human makes in the perception and use of the visual information from the cathode ray tube. The other noise source is used to simulate errors which the human makes in perception and use of the proprioceptive information.

The proposed model of the human was found to be a good approximation to the human in many respects. Some of the important aspects of the model of the human in a closed-loop tracking task are:

1. The model simulates human tracking behavior. The rms error, time-on-target, and graphic recordings of the error and control signals of the model closely matched similar data for the human as the display and control scale factors are changed.

2. The model accounts for the psychological factors of the human, such as dead-time, prediction, proprioceptive feedback, and noise.

3. The model defines human tracking behavior in terms of gain and the rms values of visual noise and proprioceptive noise. These factors are assumed constant for a skilled tracker, but may change with learning.

4. Although the effects of learning have not been investigated, the model may provide one means of accounting for learning. It might be hypothesized that as the human's tracking skill increases, the values of the visual noise, proprioceptive noise, and gain would change and would account for the change in the human's tracking performance caused by learning.

5. The model provides a useful aid to anyone interested in the design or evaluation of a control system in which the human performs a tracking task.

Microfilm $2.50; Xerox $7.00. 149 pages.

1. Elkind, J. I. "Tracking Response Characteristics of the Human Operator," USAF Human Factors Operations Research Laboratories Memorandum No. 40, Sept., 1953.

2. Krendal, E. S. "A Preliminary Study of the Power-Spectrum Approach to the Analysis of Perceptual-Motor Performance," USAF Technical Report No. 6723, Oct., 1951.

3. Walston, C. E., and Warren, C. E. "A Mathematical

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Analysis of the Human Operator in a Closed-Loop Control System," USAF Human Resources Research Center, Research Bulletin, 1954.

Abstract published by special arrangement with The Ohio State University.

OPERATION OF SEMICONDUCTOR JUNCTION DIODES AT VERY HIGH FREQUENCIES

(L. C. Card No. Mic 59-5673)

Roy Henry Mattson, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dean George R. Town

The objective of this research was to investigate the a-c electrical characteristics of semiconductor junction diodes at very high and ultra high frequencies for various d-c biasing conditions. An investigation of the electrical characteristics of gas diffused semiconductor junctions under the influence of impinging electromagnetic radiation was performed. As a result of these investigations applications of junction diodes at high frequencies became apparent and were developed.

The procedure followed was to perform an analysis resulting in the small signal high frequency a-c equivalent circuits for alloy, grown and PIN junction diodes. Then the effect of large signals on the equivalent circuits was studied, followed by experimental verification of the theoretical results using commercially available diodes. The reflection characteristics of large area gas diffused PN junction diodes were analyzed. Applications of these semiconductor junction diodes at very high frequencies were invented, and operating systems were tested.

It was predicted that an ideal semiconductor junction diode small signal a-c equivalent circuit was a current sensitive conductance when the diode was forward biased and an open circuit when reverse biased. A voltage dependent depletion layer capacitor placed in shunt with the ideal diode conductance and a shunt leakage conductance as well as a series ohmic body resistance are added to obtain the equivalent circuits of alloy, grown and PIN junction diodes. For alloy junction diodes the depletion layer capacitance varies inversely as the square root of the applied voltage, while the series ohmic body resistance and the shunt conductance are negligible. The grown junction depletion layer capacitance varies inversely as the cube root of the applied voltage, while the series ohmic body resistance and the shunt conductance are small. The PIN diode predicted equivalent circuit is a constant capacitance in parallel with the ideal diode conductance. The predicted equivalent circuit of these diodes when a large a-c signal is applied to them is the same as the small signal equivalent circuit for forward d-c bias because of the conductivity modulation effect. When reverse biased, the alloy and grown junction diodes are voltage sensitive capacitances. The analysis of large area gas diffused PN junctions predicts that the reflections from the surface of the diode can be controlled.

Measurements of commercially available diodes at very high frequencies confirmed the predictions. The variation of capacitance with voltage and the current sensitive conductance were observed. The conductivity modulation effect was also tested.

Various applications of semiconductor junction diodes were predicted, developed, and tested. Two variable reactance amplifiers which utilize non linear capacitance to provide a-c gain were designed and constructed, one operating at 10 megacycles the other at 350 megacycles. The voltage dependent capacitance of PN diodes was used to provide controllable tuning of transmission lines at high frequencies. PIN junction diodes make excellent switches and a very high frequency antenna switching system was built and tested. Two electronically controllable shorted stubs were built and tested. A device for minimizing and controlling reflections from a surface was designed. The proposed large area PN junction could minimize the reflection of impinging electromagnetic plane waves at any frequency between 5 and 500 kilomegacycles. Control was possible through the bias voltage sensitive depletion layer region. Building and testing the device was not possible because of the lack of facilities.

In this study prediction of the operation of semiconductor junction diodes at very high frequencies was accomplished. Also new uses of semiconductor junction diodes resulted from this investigation.

Microfilm $2.50; Xerox $4.60. 90 pages.

SURFACE-WAVE LUNEBERG LENS ANTENNA

(L. C. Card No. Mic 59-5952)

Carlton Harry Walter, Ph.D.
Ohio State University, 1957

It is found that a surface-wave structure can be designed to act as a lens. In particular, a sheet of dielectric on a ground plane is designed to operate as a Luneberg lens in the plane of the ground plane. The necessary variation in the index of refraction for the Luneberg lens is obtained through proper control of the velocity of the surface wave.

A TM surface-wave Luneberg lens approximately 15 wavelengths in diameter is designed and tested. Measurements are made with tapered-depthantennas (2 and 3 wavelengths long) as feed elements. A lens-type pattern is obtained in the plane of the lens and an endfire pattern (modified by finite ground plane) is obtained in the orthogonal plane.

It is found that an approximate analysis based on optical methods can be used to obtain far-field patterns that agree reasonably well with measured patterns. The pattern in the plane of the lens is obtained from an equivalent broadside radiator that replaces the lens. The pattern in the orthogonal plane is obtained by replacing the lens and ground plane by a planar array of electric and magnetic dipoles over the antenna surface where substantial tangential electric and magnetic fields exist.

Microfilm $2.50; Xerox $4.00. 74 pages.

ENGINEERING, MECHANICAL

A STUDY OF THE MEAN THICKNESS OF THE LIQUID FILM AND THE CHARACTERISTICS OF THE INTERFACIAL SURFACE IN ANNULAR, TWO-PHASE FLOW IN A VERTICAL TUBE, INCLUDING A REVIEW OF THE LITERATURE. (PARTS I AND II).

(L. C. Card No. Mic 59-4129)

David Alan Charvonia, Ph.D.
Purdue University, 1959

Major Professor: Dr. M. J. Zucrow

The results of the experimental and analytical study are described in Part I; a review of the published literature pertaining to annular, two-phase flow is presented in Part II (under separate cover).

Part I

An experimental investigation of annular, two-phase flow was conducted in a vertical tube, 2.498 in. ID and 28 in. long, employing water and air at ambient temperatures and pressures as the liquid and gaseous media respectively. Systematic experiments were conducted for determining the effect of the rates of flow of the air and water upon the mean thickness of the liquid film and the pressure gradient in the gas stream, although the latter were of secondary interest. Photographic records were made from an oscilloscope trace corresponding to the profiles of the gas-liquid interface at selected rates of flow of the two fluid media. A detailed statistical investigation of the relationship between the amplitude of the interfacial waves and their respective frequencies as a function of the rates of flow of the two fluid media was conducted. In addition, a brief experimental study was conducted for determining the region of disturbance instability wherein the crests of the interfacial waves are torn off and carried into the gas stream in the form of droplets. The liquid Reynolds number was varied from 17 to 1780; the Reynolds number of the air, when it differed from zero, was varied from $5x10^4$ to $30.3x10^4$.

An analysis of downward, annular, two-phase flow is presented and the results of that analysis are compared graphically with those from the experimental investigations.

The experimental studies were concerned with extremely thin liquid films; for example, within the region of disturbance stability at gas velocities exceeding 100 fps, the mean liquid film thickness was always less than 0.010 in.

The results of the investigation indicate that the amplitudes and frequencies of the interfacial waves are related by definite spectra and that those spectra characterize the structure of the interfacial surface. The results indicate further that the interfacial structure influences the flow of the gas in a manner similar to that of a rough wall pipe.

The analysis is based, in part, upon the latter similarity. The analysis provides a method for predicting the mean liquid film thickness and pressure gradient in the gas stream in downward, annular, two-phase flow if the rates of flow of the two fluid media, their physical properties, and the pipe diameter are known.

Part II

A review of the published literature pertaining to annular, two-phase flow is presented. The results from experimental and analytical investigations are discussed.

The review of the pertinent literature indicates that no complete theoretical solution of annular, two-phase flow is available. Furthermore, very few experimental data are available for values of the mean thickness of the liquid film and the effect of the rates of flow of the two fluid media and their physical properties upon it. Several authors have recognized the requirement of a detailed experimental study of the structure of the interfacial surface as a prerequisite for a complete understanding of annular, two-phase flow, although no such studies have been reported in the literature.

Microfilm $5.45; Xerox $19.00. 425 pages.

THE USE OF A SAMPLING VALVE TO STUDY RICH AND LEAN LIMIT PRECOMBUSTION AND AUTOIGNITION CHARACTERISTICS OF n-HEPTANE-AIR MIXTURES IN A MOTORED ENGINE

(L. C. Card No. Mic 58-7973)

William Arthur Gaubatz, Ph.D.
Purdue University, 1958

Major Professor: Dr. John T. Agnew

A modified single cylinder Waukesha fuel research engine was used to study the difference between the rich and lean limits of autoignition. The use of a four speed truck transmission, together with a variable speed motoring dynamometer allowed a speed range of 85 to 1200 rpm to be investigated. A high flow sampling valve was developed to remove samples from the combustion chamber at various crank angle positions corresponding to various degrees of completeness of the reaction. Analysis of the samples was done mainly by gas chromatography.

It was determined that the same physical characteristic differences between lean and rich autoignition existed over the speed range covered. The lean limit was characterized by a high degree of prereaction before the occurrence of the hot flame. This was evidenced by a gradual rise in cylinder pressure before the rapid increase due to the hot flame and by the actual power produced by the lean mixtures before autoignition occurred. The rich limit displayed only one sharp, explosive pressure rise due to autoignition and no power output prior to autoignition. Thus, the rich limit was characterized by lack of prereactions. This appears to be opposed to current theories of hydrocarbon oxidation. At the low engine speed of 85 rpm the rich side was observed to undergo a regular cycling autoignition in which autoignition would occur on alternate engine compression cycles. The results of sampling showed that there was a difference in the time variation of the appearance of the intermediate reaction products. The gas chromatography columns used enabled a wide range of compounds to be separated. The light hydrocarbons were separated on alumina and molecular sieve columns. The higher molecular weight

and oxygenated hydrocarbons were separated on a di-n-decyl phthalate column. Intermediate products identified were CH_4, C_2H_2, C_2H_4, C_2H_6, CO, CH_3CHO and HCHO. There were still many unidentified compounds. The sampling valve showed that there was a difference between the chemical reactions occurring at the lean and rich limits of autoignition.

Microfilm $3.65; Xerox $12.40. 281 pages.

THEORETICAL CALCULATIONS OF THE EQUILIBRIUM COMPOSITION OF RICH ACETYLENE-OXYGEN MIXTURES

(L. C. Card No. Mic 59-6483)

Charles Edwin Karabell, Ph.D.
Purdue University, 1959

Major Professor: John T. Agnew

One of the primary aims of this research was to calculate the amounts of unburned hydrocarbons and solid graphite in the equilibrium products of combustion and the mixture ratio at which solid carbon appeared. Mixtures from stoichiometric acetylene-oxygen to near the rich limit have been considered. Experiments using a laboratory burner were carried out to note the agreement, or disagreement, with the theoretical calculations.

Products considered in the equilibrium calculations were CO, CO_2, O_2, H_2, H_2O, OH, O, H, C gas, C solid, C_2, CH, CH_4, C_2H_2, C_2H_4, C_2H_6 and C_3H_4. The method presented in NACA Report 1037 was used in the theoretical determination of the flame temperature and the equilibrium composition, (17). An IBM 650 Digital Computor was used to solve the set of simultaneous equations resulting from each new approximation.

Thermodynamic data for the gaseous hydrocarbon products (C_2, CH_4, C_2H_2, C_2H_4, C_2H_6, C_3H_4) have been calculated for temperatures from 300° K to 5000° K. To accomplish this, the quantum statistical theory of heat capacity has been employed. The various vibrational, rotational, and electronic constants required by this theory have been taken from Herzberg (14,15). A comprehensive treatment of the application of this theory to the aforementioned calculations is given. Tables of these functions are included, as well as tables of thermodynamic functions for other constituents. Most of the remaining data used was taken from NACA 1037.

Also discussed is the considerable discrepancy which exists in the literature in the values of the fundamental constants used in the theoretical calculations. In particular the value of the dissociation energy for C_2 is not well defined. Also the vapor pressure of solid carbon (in which case the vapor may consist of C_1, C_2, and possibly C_3 molecules) is not well known.

The equilibrium composition of very rich acetylene-oxygen mixtures (C_2H_2/O_2 ratios greater than 1:1) consists mainly of CO, H, H_2 and unburned C_2H_2. Stoichiometric acetylene-oxygen (2.5 moles of O_2 per mole of C_2H_2) does not contain any appreciable quantities of unburned hydrocarbons in the equilibrium products. In general, however, the hydrocarbon content increased as the oxygen content of the original mixture decreased. In addition to acetylene, only methane (CH_4) and ethylene (C_2H_4) reached magnitudes which might be detectable by experimental methods. This is in good agreement with previous work done here at Purdue by Burtner (3). The flame temperature attained a maximum of 3696° K at a C_2H_2/O_2 ratio of about 1 to 1. The temperature decreased very rapidly for mixtures richer than 1:1, down to 2348° K for a ratio of 0.2 moles O_2 per mole of C_2H_2. The flame temperature decreased much less severely as the stoichiometric ratio was approached from the rich 1:1 mixture, reaching 3426° K at the stoichiometric ratio.

Microfilm $2.50; Xerox $5.00. 98 pages.

PRESSURE-INDUCED CRYSTALLIZATION IN POLYETHYLENE

(L. C. Card No. Mic 59-5198)

Shiro Matsuoka, Ph.D.
Princeton University, 1959

Due to the nature of high polymeric chains, the kinetics of crystallization of high polymer bulk systems would be expected to be much more complex than that of non-polymeric systems. The presence of the links between chain segments would (1) restrict the most probable shape of subcritical crystalline embryos and (2) prevent a continued growth of the nuclei by entanglement. A concept of "sub-embryos" has been introduced, because the most probable shape of very small embryos would be, due to restriction (1), different from the most probable shape of larger nuclei. By modifying the classical theory of phase transition with the above considerations, a kinetic theory of crystallization involving chain molecules has been developed.

The process of crystallization for high polymers has been found to be divisible into two stages; (1) primary crystallization where nuclei develop from randomly distributed "sub-embryos" and continue to grow until their further growth is restricted by the entangled amorphous regions and (2) secondary crystallization where crystallization of the remaining amorphous regions takes place through disentanglement. In general the isotherms for the crystallization would not be time-temperature superposable. The extent of primary crystallization would be a function of the rate of crystal growth as well as the mean life of "sub-embryos," and therefore it would depend on temperature and pressure. The extent of secondary crystallization would be a function of liquid heterophase fluctuations in the stable solid system.

The classical theory of heterophase fluctuations has been extended to the case of high polymer systems with due modification for the nature of chain molecules. The over-all effect of the existence of heterophase fluctuations would indicate that the amorphous state is strongly favored.

Semicrystalline high polymer bulk systems at normal "use conditions" should rarely be expected to be in true thermodynamic equilibrium. Such a metastable system due to the existence of chains (termed a state of quasi-equilibrium to differentiate it from the state of ordinary metastable two phase systems) would strongly influence the engineering properties of high polymers. Discussions

have been extended to the implications of the above in some problems of fabrication of plastics.
Microfilm $2.50; Xerox $4.80. 94 pages.

AN ANALYTICAL INVESTIGATION OF LAMINAR FILM BOILING

(L. C. Card No. Mic 59-6496)

Peter William McFadden, Ph.D.
Purdue University, 1959

Major Professor: Richard J. Grosh

An analysis was made of stable, laminar, free convection, film boiling from isothermal vertical plates and horizontal cylinders surrounded by a saturated liquid, where radiation was only of minor importance. The mathematical techniques of boundary layer theory were used and the boundary layer equations were reduced to ordinary differential equations by means of a transformation similar to those used in free convection and condensation. The equations were solved for: (1) compressible flow with variable specific heat, (2) variable specific heat and density variations considered only in the evaluation of the bouyant force, and (3) the case of constant properties. Numerical results were obtained for: (1) near critical water at 2800 and 3100 psia with wall to liquid temperature differences of 250, 500 and 1000 F; (2) for fluids with Prandtl numbers of 2/3, 1 and 2; and (3) for mercury and methanol film boiling at one atmosphere considering constant properties. The results obtained by assuming constant properties were compared to: (1) the results obtained by considering variable properties, (2) experimental results, and (3) the comparable case of laminar film condensation. It was shown that the method of considering density variations only in the evaluation of the bouyant force is not valid in film boiling. It was also shown that the constant property solutions for heat transfer did not always agree with solutions obtained considering compressible flow and variable specific heat.

An approximate analysis of a nonisothermal wall, including the effects of radiation, was presented. It was shown that for high emissivity walls at high temperature, radiation is the controlling factor in film boiling heat transfer. Microfilm $2.50; Xerox $5.20. 103 pages.

SUSTAINED AND SPARK ILLUMINATED BLACK-WHITE AND COLOR SCHLIEREN SYSTEM

(L. C. Card No. Mic 59-6509)

Randolph Bruce Renda, Ph.D.
Purdue University, 1959

Major Professor: R. C. Binder, subsequently J. B. Jones

In the study of fluid flow phenomena, properties of the fluid can be obtained if the pressure, density, temperature and the velocity distributions are known. Various methods exist to measure the pressure and the velocity distribution. Optical methods for visualizing the density field depend upon the refractive index. Of the three basic optical methods, schlieren, shadowgraph, and interferometer, this thesis focuses attention on the schlieren system, with continuous and intermittent illumination. In order to obtain such a system a photo-flash and a spark-gap light source were designed and constructed.

An optical bench was designed and constructed to house and utilize the above mentioned light sources in conjunction with a continuous light source in the system. A color-grid was made to replace the knife edge in order to convert the black-white schlieren system into a color schlieren system. This system was used to further probe and study the development of free jet discharge from a converging nozzle. A series of photographs were taken with a 35 mm camera in black-white and in color.

The system was also used to study the convective heat transfer characteristics from a heated metal sphere. A series of photographs in black-white and in color were taken. This work indicated that this system can be used to study both steady and unsteady flow phenomena. The spark-gap light source had such a short exposure time that it could "stop" any unsteady flow investigated. The color schlieren system as presented in this thesis provided more information than the black-white schlieren system. Microfilm $2.50; Xerox $6.40. 131 pages.

AN INVESTIGATION OF INTAKE MANIFOLDS FOR MULTI-CYLINDER ENGINES

(L. C. Card No. Mic 59-6518)

Everett Eugene Spitler, Ph.D.
Purdue University, 1959

Major Professor: O. C. Cromer

The object of this research was to investigate the effect of the intake manifold on the pumping ability of a six-cylinder, four-stroke-cycle, compression-ignition engine. A Caterpillar D318 engine was used; the earlier-type, stock manifold and some experimental manifolds were studied.

The pumping ability of the engine equipped with the stock manifold decreased as the speed increased from 1000 to 1800 revolutions per minute. It also decreased as the engine load was increased at a given speed. This load effect became more important as the speed was increased.

The pressure variations with time in the six ports and at five locations in the manifold were observed. The patterns were complex and of small amplitude. The amplitudes in the ports increased with speed and with distance from the common inlet. A study of the air distribution among cylinders failed to show any substantial inequalities. It was concluded (1) that the fluid vibrations in the manifold had little effect on the pumping ability, and (2) the air distribution was much more equal than the fuel distribution.

A survey of literature was carried out to study how the fluid vibrations in the induction system could be utilized to increase the air flow. It was found that extensive research had been conducted on single-cylinder engines, but very little had been done on multi-cylinder engines.

A comparison of theoretical analyses on single-cylinder engines was made. One analysis was restated to show more clearly the assumptions involved, and to modify it to include pipe friction.

Experiments were conducted on the engine at 1800 revolutions per minute to determine the optimum length-diameter combinations for individual pipes. Two combinations were considered to be of particular interest.

These two length-diameter combinations were tested with several different plenum-chamber volumes. The total air flow was measured and pressure patterns in the ports were observed. It was found that a small chamber increased interference between pipes, and also resonated at certain speeds. These effects were limited mainly to the free vibration period in the ports. Therefore, the chamber volume had only a secondary influence on the air flow. There was some indication of unequal air distribution among cylinders at certain speeds with small volumes. A general conclusion from a split-plot factorial experiment was that plenum-chamber volumes as small as the engine displacement could be used without seriously impeding the pipe effect.

With 4 feet of 2.07-inch-diameter pipe added to the 6 inch-long ports and a plenum-chamber volume equal to the engine displacement, the volumetric efficiency was improved over the stock manifold by more than ten per cent at 1800 revolutions per minute. At all speeds between 1000 and 1800, the volumetric efficiency was higher with the experimental manifold. With 2.5 feet of 1.61-inch-diameter pipe and the same plenum chamber, the volumetric efficiency was higher than with the stock manifold throughout the speed range, showing a maximum improvement of approximately six per cent.

Microfilm $2.50; Xerox $8.20. 178 pages.

A STUDY OF FLUID FLOW THROUGH FLEXIBLE ORIFICES

(L. C. Card No. Mic 59-6521)

Richard Delano Ulrich, Ph.D.
Purdue University, 1959

Major Professor: William E. Fontaine

The problem considered in this work was to develop a method for determining mass flow rates of water through a given type of flexible orifice as a function of pressure drop. The theoretical development was for rubber orifices having cylindrical holes and supported by flat back up plates having circular openings. This work was done as an introduction to the general problem of designing a flexible orifice which would produce a desired mass flow rate – pressure difference relation.

Experimentation done in trying to develop a flexible orifice which would have a constant mass flow-rate over a wide range of pressure drops yielded a large variety of flow-rate versus pressure drop relations. These curves varied from steeper than a solid orifice relation to cases where the flow-rate reached a maximum and then decreased to zero as the pressure increased. These various relations led to this investigation.

The mass flow rate was calculated from the steady state continuity equation with the velocity corrected by multiplying by a flow coefficient. The problem had two main components, the determination of the minimum orifice diameter at any loaded condition and the evaluation of the flow coefficient for that same condition. Three effects were considered in determining the minimum orifice diameter, the "squash effect" due to axial compression, the "twist effect" due to torsional rotation, and the effect of circumferential stress build up due to strain. The maximum percentage error between predicted and measured hole size was five per cent. The flow coefficients were correlated with geometric parameters and an idealized Reynolds Number which allowed for a direct determination of the flow rate. The maximum overall error of the predicted flow rate compared to the measured flow rate was about twenty-two per cent.

Microfilm $2.50; Xerox $5.20. 104 pages.

ENGINEERING MECHANICS

GAS LUBRICATED FINITE SLIDER BEARING

(L. C. Card No. Mic 59-3882)

Chao-Chow Mow, Ph.D.
Rensselaer Polytechnic Institute, 1959

Supervisor: Edward Saibel

The problem of the gas lubricated finite slider bearing is investigated in this thesis, and the method of perturbations is used to obtain an approximate solution for the pressure distribution, load capacity, and side leakage effect.

The second order perturbation pressure is determined for the solution of infinite width bearing, and the first order perturbation pressure is determined for the finite width bearing. Comparisons are made between the incompressible theory and that of the compressible theory for the infinite width case. Results indicate a shift of pressure peak in the case toward the exit end, and lower pressure rise. This agrees with experimental observations. Microfilm $2.50; Xerox $3.00. 59 pages.

ENGINEERING, METALLURGY

IMPERFECTIONS WITHIN Ti_2O_3 AND TiO_2 PHASES IN THE TITANIUM-OXYGEN SYSTEM

(L. C. Card No. Mic 59-5637)

Tatsuhiko Ejima, Ph.D.
University of Missouri, 1959

Supervisor: M. E. Straumanis

The hexagonal-rhombohedral Ti_2O_3 phase in the Ti-O system extends from 32.5 to 34.5% oxygen b.w., with the

exact composition of Ti_2O_3 nearly in the middle of the phase. Seven samples of different composition within that phase were made, and the lattice constants ($\underline{a}$ and $\underline{c}$) and the density of each sample were determined.

The plots of the constants against the composition of the samples revealed a deviation from Vagard's rule when approaching the exact composition of Ti_2O_3. The lattice constants of this compound, obtained by graphical interpolation were; $\underline{a}_{25} = 5.148$ Å, $\underline{c}_{25} = 13.636$ Å; $c/a = 2.649$ (or $\underline{a}_{25} = 5.435$ Å with the interaxial angle $\alpha = 56.575$ deg. in the rhombohedral lattice). The interpolation density of this compound at 25.0°C was 4.589 g/cm³.

The linear thermal expansion coefficients along the $\underline{a}$ and $\underline{c}$ axes were calculated from the variation of the lattice constants with temperature. There was gradual change of these coefficients with composition.

The lattice perfection of the seven samples was determined from the volume of the unit cell, the chemical molecular weight (computed from the formula Ti_2O_x) and the density of the samples. It was found that on the left side of the Ti_2O_3 phase there was an excess of Ti metal (extractable by hydrofluoric acid under hydrogen evolution from the phase), partially located in interstitial positions (up to 1.02%).

On the right half of the phase, there was oxygen in excess (in interstitial positions), the amount increasing toward the right border of the phase (up to 1.57%).

The lattice $\underline{a}$ constant decreased with increasing titanium content and increased with increasing excess oxygen content in the solid solution. The lattice $\underline{c}$ constant greatly increased with increasing excess titanium content and decreased with the excess of oxygen.

The number of interstitial atoms as plotted against the chemical composition of the samples gave a straight line, passing through the number zero within the limits of error, meaning that the lattice is sound at that composition.

The excess oxygen charges (negative) on the right side of the phase are compensated by tetravalent titanium ions.

It was found that the range of homogeneity of the TiO_2 phase extends from $TiO_{1.989}$ to $TiO_{2.006}$. The lattice constants (tetragonal $\underline{a}$ and $\underline{c}$ constants), and the densities were determined for seven samples of different color within the range of homogeneity prepared under different oxygen equilibrium pressures.

The lattice constants obtained by graphical extrapolation were; $\underline{a}_{25} = 4.5937$ Å, $\underline{c}_{25} = 2.9619$ Å, and $c/a = 0.64478$. The intrapolated macroscopic density at 25.0°C was 4.2441 g/cm³.

The linear thermal expansion coefficients along the $\underline{a}$ and $\underline{c}$ axes were: $\alpha_a = 6.88 \times 10^{-6}$, $\alpha_c = 9.91 \times 10^{-6}$.

The lattice perfection of the samples was determined. It was found that on the left side of the phase there were oxygen vacant sites (up to 2.06%). On the oxygen side, there was an excess of oxygen, probably in interstitial positions, which increased with increasing oxygen content toward the border of the phase (1.20%).

The lattice $\underline{a}$ constant increased with increasing oxygen content by a parabolic relation (positive deviation from Vagard's rule).

The lattice $\underline{c}$ constant decreased with increasing oxygen content by a parabolic relation (negative deviation from Vagard's rule).

The number of oxygen vacant sites as plotted against the composition of the samples gave a straight line, passing through the number zero within the limits of error, meaning that the lattice at that composition is sound.

From the plots of the equilibrium oxygen pressure against the composition of the samples, it was found that the dissociation pressure of TiO_2 at 1400°C is approximately 2/3 of the atmospheric pressure.

Microfilm $2.50; Xerox $8.60. 190 pages.

HIGH TEMPERATURE SCALING OF NICKEL-MANGANESE ALLOYS

(L. C. Card No. Mic 59-5987)

Edward B. Evans, Ph.D.
Case Institute of Technology, 1958

An experimental study and a correlated literature review were made of the high temperature scaling behavior in air of nickel, manganese, and nickel-manganese alloys (4-47% Mn). All the alloys and the pure component metals scaled according to the parabolic rate law between 600° and 1000°C. At any given temperature the scaling rate increased sharply with low manganese additions, then levelled off at intermediate concentrations, approaching the scaling rate of manganese as the upper limit.

Both a subscale and an external scale were formed on the alloys, the scale composition being a function of alloy composition and temperature. Above a critical concentration of manganese (15 per cent at 600° to 60 per cent at 1000°C), the external scale consisted exclusively of manganese oxides; the subscale was MnO. Below this critical concentration, complex external scales consisting of the oxides of both nickel and manganese were found along with subscales of either NiO or a solid solution of the monoxides (MnO+NiO). The spinel oxide ($NiO \cdot Mn_2O_3$) found in most of the complex external scales was not associated with improved oxidation resistance. Schematic isothermal sections of the deduced Ni-Mn-O phase diagram were applied as an aid in interpreting the scaling behavior.

Microfilm $2.50; Xerox $3.60. 62 pages.

A THERMODYNAMIC STUDY OF THE ZIRCONIUM SULFIDES

(L. C. Card No. Mic 59-5643)

Andrew Hessler Larson, Ph.D.
University of Missouri, 1959

Supervisor: A. W. Schlechten

A hydrogen reduction technique was used to determine some thermodynamic properties of various zirconium sulfide phases. The equilibrium H_2S/H_2 ratios were determined as a function of temperature and composition of the condensed sulfide phases. The hydrogen sulfide content of the equilibrated gas mixtures was analyzed by an iodimetric titration procedure.

A detailed description is given for the method and apparatus used both in the preparation of the various sulfide phases and in their equilibration with a hydrogen-hydrogen sulfide gas mixture.

The composition range 59 to 67 atomic per cent sulfur was studied over a temperature range of 500° C to 900° C.

Within this composition range there existed a two phase region of the Zr_3S_4 and ZrS_2 type phases. The upper limit of this two phase region was bounded by a disulfide phase of a composition which was practically constant over the temperature range investigated. The lower limit of this two phase region was bounded by a Zr_3S_4 phase composition which varied appreciably with temperature. The upper limit of the disulfide phase solid solution was not definitely determined, but appears to be bounded very closely by the stoichiometric composition of ZrS_2. The lower limit of the Zr_3S_4 phase solid solution was not determined due to the extremely low values of the equilibrium H_2S/H_2 ratio.

The partial molar free energy, partial molar enthalpy, and partial molar entropy of solution of sulfur were calculated for various composition existing in the solid solution regions. A two term free energy equation was calculated for the two phase region of the Zr_3S_4 and ZrS_2 type phases. The standard free energy of formation of the zirconium sulfide phases in the composition range 59 to 73 atomic per cent sulfur was determined from unpublished zirconium oxide-sulfide equilibrium data and published data for the ZrS_3-ZrS_2 equilibrium by means of a graphical method for a temperature of 900° C.

Microfilm $2.50; Xerox $6.00. 122 pages.

A STUDY OF THE PHENOMENA ASSOCIATED WITH THE SCALING OF ZIRCONIUM AT ELEVATED TEMPERATURES

(L. C. Card No. Mic 59-5980)

Hubert Bernard Probst, Ph.D.
Case Institute of Technology, 1959

The three phenomena observed in the scaling of zirconium, i.e., the change in scaling rate, the color change of the oxide, and growth of the underlying metal were investigated in the temperature range of 600 to 1300°C.

Zirconium initially scales at a relatively low rate which, in time, yields to a faster scaling rate (breakaway). Experimental results suggest that breakaway is the result of scale cracks leading to a more rapid oxidation.

The initial oxide that forms on zirconium is black. This oxide transforms to white upon continued scaling. X-ray analyses revealed no difference between these scales, both are composed of tetragonal and monoclinic ZrO_2 with the monoclinic form predominating. This color transition appears to be due to the absorption of the oxygen and/or nitrogen.

The growth suffered by zirconium is the result of a deformation process rather than a volume expansion. In air, the presence of a thin layer of zirconium nitride between oxide and metal is instrumental in causing growth. In oxygen, oxide "fingers" penetrating the metal appear to be responsible for growth.

Microfilm $2.50; Xerox $7.80. 168 pages.

HYDROGEN EMBRITTLEMENT AND STRAIN AGING IN TITANIUM ALLOYS

(L. C. Card No. Mic 59-5981)

Richard John Quigg, Ph.D.
Case Institute of Technology, 1959

Low strain rate embrittlement in titanium alloys can be classified as a strain aging phenomenon. Prestraining and aging an alpha-beta titanium alloy resulted in a ductility minimum at some intermediate aging time. It appears that hydrogen migrates to a region of inhomogeneous strain, where a high stress state exists, and creates this embrittlement. The restoration of ductility at long aging times was attributed to low temperature recovery with subsequent redistribution of hydrogen.

Low strain rate hydrogen embrittlement was obtained for an alpha alloy and a beta alloy. Hydrogen in small quantities seemed to aid creep resistance in the alpha alloy. The beta alloy was resistant to nominal quantities of hydrogen (420 ppm), but did show embrittlement at higher levels.

Microfilm $2.50; Xerox $4.20. 79 pages.

A TEST FOR ELECTRON TRANSFER IN THE INTERMETALLIC COMPOUND V_4Al_{23}

(L. C. Card No. Mic 59-5675)

Alden Earl Ray, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Professor John F. Smith

Abnormally short interatomic distances are characteristic of aluminum-transition element compounds which occur at the aluminum-rich ends of the phase diagrams. A theory has been proposed which suggests that these short interatomic distances are due to a transfer of some of the outer electrons of the aluminum atoms to the unfilled 3d orbitals of the transition metal atoms. In the present investigation, x-ray diffraction techniques have been employed to test for spatial transfer of electrons in the intermetallic compound, V_4Al_{23}.

Three dimensional intensity data have been collected from a spherical crystal of V_4Al_{23} by the moving crystal-stationary counter technique. These data have been corrected for the effects of absorption, dispersion, secondary extinction, and anisotropic thermal motion of the atoms. It has been shown that reflections for which $\sin\theta/\lambda > 0.29A^{-1}$ should be insensitive and reflections for which $\sin\theta/\lambda < 0.29A^{-1}$ should be sensitive to the distribution of the outer electrons. The intensity data for which $\sin\theta/\lambda > 0.29A^{-1}$ were used in (F_o-F_c)-syntheses to refine atomic coordinates and temperature factors and to place all the intensities on an absolute scale. An R value of 0.057 has been obtained for the structure refinement. After successive refinements of the structural parameters had minimized the (F_o-F_c)-synthesis of the intensity data for which $\sin\theta/\lambda > 0.29A^{-1}$, a three dimensional (F_o-F_c)-synthesis was computed with the intensity data for which $\sin\theta/\lambda < 0.29A^{-1}$. This synthesis revealed how the actual

distribution of the outer electrons, given by the observed structure factors, differed from spherical distributions of outer electrons about atomic sites, represented by structure factors calculated with theoretical scattering factors for isolated atoms.

The final (F_o-F_c)-synthesis did not indicate a spatial transfer of electrons from the aluminum atoms to the vanadium atoms to the extent implied by the theory noted above. However, strongly positive regions occurring in the (F_o-F_c)-synthesis have been interpreted to indicate a directional character to the bonding interactions among small groups of atoms in the V_4Al_{23} structure. Further interpretation has been that all of the aluminum atoms and six of the eight vanadium atoms in the structure contribute approximately equal numbers of electrons to participate in the bonding, while the remaining two vanadium atoms contribute a smaller number of bonding electrons. Magnetic susceptibility measurements have shown that V_4Al_{23} is feebly paramagnetic with little temperature dependence while in pure vanadium the paramagnetism is comparatively strong. These measurements indicate that electrons which are unpaired in pure vanadium are paired in V_4Al_{23} and suggest that levels arising from atomic d-states in vanadium participate in the bonding in V_4Al_{23}. However, the hybridization must be such that spatial localization of the bonding electrons around the vanadium atoms is not pronounced. Microfilm $2.50; Xerox $3.00. 47 pages.

DELAYED FAILURE IN HIGH STRENGTH STEEL

(L. C. Card No. Mic 59-5983)

Edward Anthony Steigerwald, Ph.D.
Case Institute of Technology, 1959

Low temperature testing was employed to analyze the delayed failure process in hydrogenated high strength steel. The kinetics of crack propagation indicated that cracking progressed in a discontinuous fashion. Delayed failure thus involves a series of crack initiations rather than the growth of a single crack.

The initiation of localized cracking was found to be dependent on the development of a critical hydrogen concentration and relatively insensitive to the magnitude of the applied stress in the delayed failure range. The stress played an essential role by providing the means for grouping the hydrogen. Assuming that the rate of stress-induced diffusion was a direct function of the applied stress, the calculated relationship between incubation time and stress agreed reasonably well with experimental data.

The lower critical stress was defined as the minimum stress required to produce the critical amount of hydrogen segregation required for crack initiation. A distribution law involving hydrogen concentration, applied stress, and temperature was assumed. On the basis of this law the observed changes in the lower critical stress as a function of notch acuity, strength level, temperature and initial hydrogen content were predicted over a significant range of these variables.

Microfilm $2.50; Xerox $4.40. 81 pages.

ENGINEERING, SANITARY & MUNICIPAL

EFFECT OF PREAERATION ON PRIMARY TREATMENT OF SEWAGE

(L. C. Card No. Mic 59-5678)

Harris Forrest Seidel, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: E. Robert Bauman

The objectives of this study were to evaluate:

a. the effect of preaeration on primary settling of sewage;
b. the factors which in turn affect the results achieved, and
c. the economics of the preaeration process.

As defined for purposes of this study, preaeration is limited to an air-agitation pretreatment of raw sewage, ahead of primary settling. No chemicals, digester supernatant, sludge or any other materials which might act as a physical or biological aid to flocculation are added or returned to the raw sewage.

The work was done principally on full-plant scale at the Ames, Iowa municipal sewage treatment plant. The Ames plant is a standard-rate trickling filter plant of conventional design, receiving an average flow of $2\frac{1}{2}$ mgd. For this study, the primary clarifiers were arranged as two parallel, identical settling bays, one preceded by 45 min preaeration, the other with no pretreatment. An accurate split of the raw sewage flow between the two primary treatment bays was maintained. During the plant tests, various methods of air diffusion were used and the aeration rate was varied over wide limits.

Preaeration proved to be of consistent benefit to primary settling. Ames plant results averaged 7 to 8 percentage points improvement in both primary BOD and SS removal following preaeration. The degree of improvement appeared to be unaffected by the strength of the raw sewage, the aeration rate (0.08 to 0.24 cu ft/gal), or the method of introducing air. On the other hand, it did appear to show a correlation with the efficiency of plain settling. Preaeration was of greater benefit when plain settling was least effective, and vice versa.

Preaeration was found to be highly effective in grease and grit separation. It is imperative that their removal be considered in the design of preaeration facilities.

Preaeration is a physical approach to waste treatment; its value lies primarily in its flocculating effect and in the resulting improvement in settleability. Of equal importance is the delivery of the preaeration effluent to the primary clarifier with settleability unimpaired.

Where preaeration is credited with improved primary removals, secondary treatment facilities may be reduced accordingly. However, from the standpoint of both first cost and operating charges, preaeration appears at a slight disadvantage under conventional design criteria. If credit were given for the sharply accelerated settling following preaeration, in terms of reduced primary settling detention time, this cost disadvantage would disappear. Therefore, the preaeration process should be considered on its merits in each design situation. Along with such tangibles as cost and primary removal, the less tangible factors of grease and grit removal and improved 'treatability' must also be evaluated.

Microfilm $3.05; Xerox $10.40. 233 pages.

WHISTLER AND THE AESTHETIC MOVEMENT

(L. C. Card No. Mic 59-5153)

Eugene Matthew Becker, Ph.D.
Princeton University, 1959

The American-born painter, James McNeill Whistler, played a significant role in the history of English art in the second half of the nineteenth century. His role was not only significant but unique because—as his friend and critic, George Moore, pointed out—he was a cosmopolite: born in America, reared in Russia, trained in France, and established in England. Thus, Whistler was always in a position to be influenced by ideas from many sources and to transmit them as well. This thesis, then, analyzes the works and the art theory of Whistler insofar as they relate to those English artists traditionally considered members of the aesthetic movement. Whistler derived inspiration from these aesthetes, but also richly endowed the movement with some of his own intellectual and artistic contributions.

Such an analysis demands a careful definition of the various pictorial and theoretical ideas converging at that point in history which allowed for the relationship which is the title of this thesis, Whistler and the Aesthetic Movement.

During his mature years, Whistler worked in both London and Paris, acting as a correspondent for artistic ideas between the continent and England. The first part of this dissertation, therefore, consists of a brief biography of his life, concentrating primarily on those points of historical connection between the artist and his friends in the two cities.

The term "aesthetic movement" has been a vague one in the history of English art, for the historical connections between the Pre-Raphaelites and the aesthetic movement have never been closely argued and defined. The writer contends that the aesthetic movement must be considered a part of the activities, many and varied, of the Pre-Raphaelite Brotherhood—and not separate from it. The thesis includes, therefore, a discussion of the Ruskinian tradition of the moral subject in the paintings of the Pre-Raphaelite Brotherhood. An analysis follows of the seeds of discontent within the Brotherhood that led to the formation of a group of "aesthetes" who broke with the Ruskin doctrine. The aesthetes painted "decoratively" (Rossetti, William Morris, and Burne-Jones) and argued art as its own value (Walter Pater, Algernon Swinburne).

Whistler is related to this dissident group within the Pre-Raphaelite Brotherhood not only in terms of his art but also in terms of his critical writings. The critical ideas of the conservatives and aesthetes within the Brotherhood revolved about two fundamental concepts in the pictorial arts which for them carried specific meanings: truth and beauty. Generally, truth in painting referred to the subject in painting with its many ramifications, including its moral didactic purpose, its attempt to imitate nature, and its attempt to be historically and archaeologically correct. Beauty referred to the more purely abstract elements of line, color, and form in painting. How Whistler—carrying with him from France the art for art's sake ideas of Baudelaire and a revived interest in Japanese decorative art—followed the English aesthetes and became a distinguished advocate of the superiority of beauty over truth in painting is the central focus of this dissertation.

As the aesthetic painters struggled for recognition in the art world of London, they confronted unbelievable disdain from professional journalist-critics who were supposedly responsible for the free flow of critical evaluation between the artists and the public. How these critical battles reflected a more serious phenomenon in the nineteenth century, namely, the gradual spiritual isolation of the artist from an appreciative public, is the final problem considered in the dissertation.

Microfilm $4.40; Xerox $14.80. 341 pages.

A STUDY AND SPECIFICATION OF ART APPRECIATION IN TERMS OF THE STRUCTURE OF VISUAL PERCEPTION

(L. C. Card No. Mic 59-5352)

Erwin Millard Breithaupt, Jr., Ph.D.
The Ohio State University, 1953

The dissertation is concerned with the problem of teaching art appreciation. Specifically, it is concerned with an approach that will provide the student with a functional and actional basis for making esthetic judgments. This concern made it necessary to examine a variety of ideas and programs now used in the teaching of art appreciation. Besides being contradictory many of these ideas, in the light of known facts about organismic-artistic processes, had no "warranted assertibility." Generally, most of them were grounded in philosophic or historical methods and were bound by the traditional limitations of those areas. Examination of the use of such points of view revealed that they had little effect upon the student's capacity for esthetic judgment.

In spite of the failure of these programs, they were of immense value to this inquiry. Under close examination, the general patterns of their confusions began to emerge. Once these confusions were established, the weaknesses of their assumptions and conclusions became apparent. The inefficacy of the present teaching of art appreciation can now be corrected, that is, stated in functional terms and dealt with concretely.

The dissertation is concerned with the development of a point of view that places emphasis upon the individual's perceptions in relation to esthetic form. It will show that an awareness of the factors inherent in perception makes

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

it possible for a more conclusive and related study of the visual arts. It is hoped that such a method will provide the student with an effective means for engaging actively in the appreciation and evaluation of the visual arts.

The development of this method is undertaken by the explication of six major points: (1) the specification of the terms used in this inquiry; (2) the criticism of the system of "identity"; (3) the criticism of the terms "art" and "appreciation"; (4) the specification of the term "art"; (5) the specification of the term "appreciation"; (6) the explanation and application of fundamental visual phenomena (Visual Demonstration Center, The Ohio State University).

The specification of the terms used in this inquiry. — The dissertation is based on a fundamental treatment of visual perception as it relates to art appreciation. Perception is treated as a transactional process. Therefore, a specification of perception and transaction is given. Terms implicit within (e.g. past experience, purpose, action, specification) and necessary to the latter are classified.

The criticism of the system of "identity." — A criticism of the Aristotelian system of "identity" is undertaken to show the limitations which must be removed before a more functional and operational ground for art appreciation can be provided. From this criticism of the system of "identity," two major points emerge: (1) on the false assumption, largely because of past experience and common usage, that the "is" of predication is true to fact, the organism-as-a-whole is forgotten. The perceptual process, either on the part of the creator or the beholder, becomes self-actional and therefore largely figural in nature. Resulting evaluations are delusional in character, as they are false to fact to begin with. Regardless of their literary merit, they can lead to nothing but the most primitive and elementalistic habits. (2) Dependence upon this system leads to sever contradictions between what may be named as the "creative act" and "observer reaction." The tendency to rely on the predicative operation from common experience strengthens belief in its ultimate reaches. The organismal-environmental-transactional process is foregone. Structure as a relational factor is either superficially postulated or else unconcernedly bypassed. By ignoring the electro-colloidal process of abstracting, evaluations come to be placed out in the object, resulting in misevaluations.

The criticism of the terms "art" and "appreciation." — This criticism amplifies the ambiguous and nondefinitive character of the terms "art" and "appreciation" as used by other authors. The criticism specifies the necessity for a re-examination of the conditions which permit such semantic conclusions to be drawn. Such noted authors and critics dealing with the visual arts as A. Barnes, O. Benesch, T. Greene, and L. Venturi are critically examined.

The writings of the various authors criticized, though inconsistent with present empirical behavioral data, may be perfectly harmless if taken at the proper level in the abstracting process. Concern for these writings arises from the fact that many of them have been assigned a doctrinal position within the area of art appreciation. Those who have used them to force an issue of rules have led a parade of individuals toward an unsound position regarding the creative act. Removal of such unsoundness can be achieved by the full use of the cognitive acknowledgment that the artist-in-process and critic-in-process are abstracting from basically different levels. Both are confronted with entirely different stimulus patterns, with unique and individual systems, and to expect a sameness in both emergents is erroneous.

The specification of the term "art." — A specification of the term "art" is given from an analysis of the organism as an abstracting agent in a perceived environment. "Art" is then specified on the basis of the abstracting processes of the organism in six interrelated steps.

1. It is seen that all art ("art" used here in the restricted sense of a man-made product) is concerned with happenings, whether external (landscapes, models, still lifes, etc.) or internal (thoughts, dreams, myths, etc.).
2. All art is a result of electrocolloidal reactions to immediate physicochemical electrocolloidal nervous impacts.
3. In turn, art is a forming process, dependent on and centered in the structure of the processes of abstracting.
4. As such, art remains at a nonverbal level, concerned only with the evaluation of cortical configurations in terms of projection limited by the material in which an individual is working.
5. Such factors as past experiences, purposes, goals, drives, etc. are electro-colloidal in character and are considered here as other impingements affecting the "feelings," "thinking," "emotional," character of any given nonverbal art projection.
6. Art is a specific and unique form, to be evaluated from its individual position on the basis of the perceptual processes which control the purposive nature of the individual creator.

The specification of the term "appreciation." — "Appreciation" is examined in the light of the preceding analysis and is specified from an organismic-environmental point of view.

The major premise of the dissertation is that "appreciation" involves the equivalent "phase sequence" of the process of abstracting. Given a particular work of art (happening) which sets off a series of "firings" in the neuro-system and following these through to the affected cortical centers, the stage is set for varied types of reactions. One may occur on the nonverbal level of the motor-geniculate-viscera system. A more complex response may be developed at the linguistic level. Regardless of whether the response is verbalized or not, the act of appreciation is transactional in nature.

Critical to the act of appreciating is the full realization that it is a process-centered activity directly related to, and controlled by, the fundamental characteristics of perceptual behavior. The ability of an organism to appreciate works of art is directed by its capacity to control its past experiences, its purposes, and its actions in the process of perceiving.

Therefore, it is proposed that the emphasis for "appreciating" works of art be placed on the processes intrinsic to perceptual behavior. In this way, "appreciation" is developed as a functional, actional, and operational term.

The explanation and application of fundamental visual phenomena (Visual Demonstration Center, The Ohio State University). — A series of visual demonstrations, which offer significant disclosures regarding the origin and nature of perception are used to effect a relatedness between the inquiries as noted above and the actualization of

common experiences. This inquiry shows that these demonstrations clearly provide a basis for the construction of an internal frame of reference which releases the individual from introjected valuations, thereby allowing for greater security in the discriminatory judgments made by the individual. The inclusion of these demonstrations of fundamental visual phenomena shows how the teaching of art appreciation can be made more effective.

In summation, the demonstrations provide a laboratory situation where the assumptions of this dissertation may be tested and observed. Much of that which has been called the "mystery" in the creative phase of the artist-in-process can be transferred to a level which is open to empirical verification. These demonstrations provide a dramatic situation whereby the layman can be shown more effectively a functional procedure for the manipulation of his own experiences in ascribing value to art objects of the past and present. Space does not permit either a description or an analysis of the visual demonstrations as presented. However, from the demonstrations the following conclusions are drawn.

1. Star point demonstration. — The whole of the demonstration affirms for the observer the critical nature of the cue of position as related to the perceptual environment and thus to art. The course of experiences as witnessed is dependent on whether the star-point, or points, are positioned in a blacked-out or lighted situation. In the former, apparent motion of the points of light is perceived but in the latter the point is seen as fixed. This demonstrates not only the importance of position of figure but also the ground which assumes position within the phenomenal field. Positional relationships are therefore primary to the strivings of goal-directed organisms and necessarily become instrumental, functional activities of appreciative development.

2. Balloon demonstration. — This demonstration shows that size, for the artist or designer, is primary to integration and becomes an esthetic quality rather than a mere sign for "distance" or "depth." The student must be prepared then to suppress his customary experiences with size phenomena in order to gain a fuller appreciation of the purposive nature of the creating organism. For critical differentiation between the ordered emergent and non-esthetic projections, the student must become aware of the conflicting assumptions which are shown through the experiencing of this demonstration. Its inherent value is not that it points out the serial connections in works of art but rather that it points up the necessity for the reorganization of the observer's perceptions in relation to the viewing of creative works.

3. Telephone pole demonstration. — Extending the implications of this demonstration brings to light the importance of differentiating between the nonverbal and verbal levels of abstracting. By so doing, it is possible to clarify for the student the necessity of removing the clause of identification in order that his response to given situations may be more in accord with his own abstracting processes, thus enhancing the possibility for more stable behavioral responses to be instituted.

With this as a basis, the student can be shown the necessity for suppressing his object-directed attitude when coming into contact with works of art. Since esthetic organization can be structured only in the formal abstractions of position, color, size, overlay, etc., regardless of the emergent "subject," the looker must be prepared to give attention to these cues in order to perceive what has been projected by the creator. Otherwise, there will be a tendency to confuse the art form with the referent, with the result that fresh experiences of appreciation are inhibited. This ends in a tendency of seeing in cliches.

4. Cube demonstration. — For the course of art appreciation, this demonstration clearly establishes that past experience is of major consequence in determining "what is seen."

Determination of this point is necessary before the observer is in a position to modify his point of view concerning all art activities. Before he can get at the structural essence of art objects, regardless of their moment, he must be prepared to assume that his past experiences do not always deliver a confirmation of what is seen. It is shown that before any significance of art as such may be had many of his experiences may need to be suppressed before new experiences may be actualized.

5. Trapezoidal window demonstration. — This demonstration continues to emphasize the necessity for being "centered in process" rather than allowing an "object-directed" attitude to govern the observer's perceptions. As long as the organism's projection system is aligned with size as sign for distance (object-directed), what he sees will be in conflict with what is inherent in the nature of the structure out there. The full impact of this in related areas of the visual arts calls for the removing of such clichés as style, perspective, realism, idealism, romanticism, cubism, etc., before any functional and actional realized esthetic behavior can take place.

6. Distorted room demonstration. — This demonstration provides a series of experiments by which individuals may dramatically review the relation of past experience to action in perception. It discloses to the observer the reasons for structuring information in action. It points up that, although talk and readings about art may be an inroad to appreciation, until these verbalizations are checked out through active participation they remain nothing but literary passages. For the student to submerge himself in the act of doing is more sufficient and, in the long run, a more exacting method for the evaluation of art works.

7. Pattern integration demonstration. — Having experienced this phenomenon, the student is offered a simple level explanation of the term integration. The demonstration shows that integration is a process of sensory articulation dependent upon the point of view of the observer and not upon the inherent nature of the artifact under view. Therefore, the dynamics of the transactional phase of integration are determined by organismal responses in the cycle of perceptual activity. This makes it possible to point out that integration as a phase of creativity is not disclosed by the artifact alone but is dependent on the observer's ability to achieve it in his own transactions.

8. Gray ring demonstration. — The basic objective of this demonstration is to show that it bears out some earlier assumptions concerning the point of view of the potential appreciator. The demonstration shows that a concern for subject matter or style characteristics (object-directed) in art tends to inhibit integration in perceptual responses. The total field requisite to verification of forming processes at the level of esthetic organization is impeded. In order that esthetic integration may be actualized, maintained, and enhanced by the perceiving organism, it becomes necessary to suppress the object-directed attitudes of routine perception.

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CONCLUSIONS

1. The teaching of art appreciation by individuals who rely on personal biases and unexamined assumptions has failed to change the perceptual behavior of students who study such courses. Therefore, social patterns or individual attitudes towards esthetic form remain largely unaffected.

2. Instrumental to all visual art activity, whether it be in the act of creating or appreciating, are the basic components of perception.

3. The dissertation entails a significant shift in method for the study of art appreciation. It considers art as basically an artificial form which emerges as a transactional result of an organismic response to a given set of stimuli.

4. To remove many of the ambiguities surrounding the terms "art" and "appreciation," the traditional application of the "is" of identity and its accompanying Aristotelian system must be suppressed. The "is" of predication makes it difficult for the perceptual processes to be treated properly, and evaluations concerning the visual arts remain within primitive and elementalistic limits. Dependence on this system results in severe contradictions between the "creative act" and "observer reaction." The acceptance of the "is" of identity in evaluating the visual arts leads to criticisms which are largely animistic, primitive, and false-to-fact.

5. A criticism of the terms "art" and "appreciation" as used by other authors points to the unsuitability of their use for this dissertation.

6. "Art" is specified from an electro-colloidal point of view, with emphasis placed on the process of abstracting common to all organisms. That which differentiates "art" from common responses is the unique form projected in a particular material at a non-verbal level. The forming process is organismic in nature, dependent on the organism's ability to handle the cues given in its perceptual processes which are requisite to a unified projection. Thus this specification of "art" is concerned with organismically-centered processes rather than with end products.

7. "Appreciation" is specified basically from the point of view just stated. It is concluded that the emphasis for "appreciating" works of art be placed on the processes intrinsic to perceptual behavior. Thus "appreciation" is developed as a functional, actional, and operational term.

8. To show the direct relationship which holds between the common and unique responses of perceptual behavior and "art appreciation," an explanation and application of a series of visual demonstrations from the Visual Demonstration Center at The Ohio State University are undertaken.

These demonstrations make explicit that an observer's response to an hierarchy of visual cues is determined by the integration of certain past experiences which are appropriate to his specific purpose of the moment.

Thus it is shown that for an appreciation of works of art to take place, the commonality of perceptual behavior must be reorganized through a shift in purpose in order that new experiences may be had on which to base esthetic judgments. Microfilm $2.70; Xerox $9.40. 206 pages.

Abstract published by special arrangement with The Ohio State University.

AN ANALYSIS OF SOME MAJOR FORMS OF ORNAMENT IN MOZARABIC ILLUMINATION

(L. C. Card No. Mic 58-3225)

Jacques Guilmain, Ph.D.
Columbia University, 1958

The sources of the ornamentation in the large group of Mozarabic illuminated manuscripts made in León-Castile during the tenth and eleventh centuries remain largely to be discovered. In respect to both the figural images and the abstract and zoomorphic decoration, the formative role of the East has been greatly stressed, although some Northern influences have been noted, particularly in respect to the complex interlace decoration used in the construction of frames, canon-tables, and initials. However, no careful analysis of the interlace decoration in these Spanish works has been done, nor has any estimate of the true extent of the penetration of Northern forms been made. The possibility that the style of the illuminations in the manuscripts of León-Castile represents the survival of a Spanish art of Visigothic times, of which no secure examples have come down to us, has also been considered.

A review of the literature on interlace decoration reveals that, through careful analysis, interlace ornaments can be classified into two great families, both arising initially from classical forms; the Constantinian, and the interlace with breaks. The interlace with breaks is the type which becomes developed into a fantastically intricate decorative art in Hiberno-Saxon illuminations of the seventh and later centuries, and appears also in modified form in Carolingian ornamentation deriving from the insular.

An analysis of the interlace decoration in some key tenth century manuscripts of León-Castile reveals, not only that this type of ornament in the Spanish works must derive primarily from Hiberno-Saxon prototypes, but specifically from the latter's Carolingian variants, as they are found, for example, in the manuscripts of Tours and Franco-Saxon works. Influences from Coptic art in relation to this type of ornamentation appears extremely unlikely. However, in relation to contour decorations, influences from Coptic and Moslem art seem to have played a greater role.

The literature on zoomorphic decoration gives virtually no mention of the possibility of Northern influences in the tenth century manuscripts of León-Castile, but, again, gives the impression of strong borrowings from the East. There can be no doubt that much of the animal ornamentation in the Spanish manuscripts derives from Eastern prototypes. However, comparisons with Northern zoomorphic types, which were themselves influenced by Oriental models, force us to conclude that it is from these forms that many of the Spanish variants derive.

The evolution of certain families of zoomorphic decorative types which appear in Germanic, Scandinavian, Insular, and Northern Continental art has been carefully studied by a number of scholars. Some of these Northern forms clearly found their way into the decorative vocabulary of the manuscripts of León-Castile; these Northern types, as they appear in Spanish illumination, evidently derive from Carolingian models.

An analysis of some compositional features in the

Spanish works shows, again, that Northern practice was a strong influence in the structure of the decorated pages.

We must conclude, therefore, that, by the middle of the tenth century, Mozarabic decoration had acquired a distinct Northern stamp. Nevertheless, the art of decoration in tenth and eleventh century manuscripts of León-Castile is not merely eclectic; it is a new type of ornamentation with its own vital character.

Microfilm $3.50; Xerox $11.80. 269 pages.

GEOGRAPHY

EAST PAKISTAN: A STUDY OF POLITICAL GEOGRAPHY.

(L. C. Card No. Mic 59-6182)

Donald Lockhart Atwell, Ph.D.
Clark University, 1959

Supervisor: S. Van Valkenburg

East Pakistan came into existence as a political unit in 1947 when British India achieved independence and was partitioned into India and Pakistan. The latter state was created to include the Muslim majority districts of British India which were concentrated in two areas separated from each other by more than 1,000 miles. While the inclusion of discontinuous territory in a modern state is by no means unique, none prior to the creation of Pakistan had consisted of two parts so widely separated, containing such a very nearly balanced division of the country's population.

This study is an examination of the internal and external relationships of the political unit, East Pakistan, as they reflect the interaction of geographical attributes with political, social and economic factors. Particular attention has been focused on East Pakistan's role in the state of Pakistan. Commencing with an examination of the unit's geographical attributes, the study continues with an outline of the history of the Pakistan movement. Demographic and linguistic aspects are then discussed as well as the role of religion in the state. Observations have been made on the origin and functions of the unit's boundaries and among the economic factors food production, resource availability and potential industrial development and transport have been singled out for particular attention. The study, concluding with a commentary on political dynamics, examines the relevant aspects of the provincial and national political scene, administrative structure and foreign relations.

Though the political entity of East Pakistan possesses a marked degree of unity because of a common linguistic tradition and a dense, compact settlement pattern, these must be weighed against formidable barriers to internal communication created by three major rivers and the presence of a significant religious minority. In many respects it is a more homogeneous political unit than West Pakistan, but this, too, is counterbalanced by the greater centrifugal forces which the eastern province is subjected to because of closer geographic and cultural ties with India.

Distinction is lent to East Pakistan's situation in that with more than half the country's population neither the federal capital nor the political core of the nation is included within its boundaries. Influence and participation in the federal government has not been commensurate with relative population or the income from East Pakistan's jute which is responsible for more than half of the country's foreign earnings.

Despite market expansion of the industrial plant in the more than ten years since partition, economic viability remains marginal. During the period, agricultural productivity, the key to any economic improvement, has increased very little. In addition, the economies of East and West Pakistan continue to be less complimentary than each is, or could be, with adjacent areas of India. The most persistent forces straining the political association of East Pakistan with Pakistan are not, however, as directly related to the great economic, geographical and cultural differences that exist between them as they are to governmental policies and the nature of the federal structure. While these forces have been responsible for dissatisfaction with East Pakistan's role in Pakistan, there is a little evidence to suggest that independence is widely sought or that popular sentiment favors reunion with India. The traditions of the Islamic community and a desire not to return to a minority position in India continue to provide a raison d'être for the political unit and a bond with West Pakistan.

Microfilm $4.55; Xerox $15.20. 354 pages.

INTRAURBAN VARIATION OF RESIDENTIAL QUALITY

(L. C. Card No. Mic 59-6183)

Roland John Fuchs, Ph.D.
Clark University, 1959

Supervisor: Raymond E. Murphy

It has been observed that cities differ in the degree of internal variation of residential quality which they exhibit, i.e., some cities appear fairly uniform in quality while others are more varied. In essence, the problem of this study was to quantitatively measure the degree of internal variation in residential quality as it differs from city to city and to describe the association between it and other urban phenomena which also differ areally.

Since residential quality is a characteristic not precisely measurable, housing cost, as measured by monthly contract rent for tenant occupied dwelling units and a rental equivalent in the case of owner occupied one dwelling

unit structures, was decided upon as the most satisfactory available indicator of quality. The basic data were contained in the 1950 Census of Housing. However, certain "open end" categories used by the census in reporting rent and house value data required the redistribution of the values in these categories, by a method employing block housing data and the study group was thus limited to the 209 cities for which 1950 block housing data are available.

The coefficient of variation was chosen as the best relative measure of dispersion and was computed for each city on the basis of housing costs. The mean of the coefficients of variation was 73.09 with the distribution having the approximate form of a normal curve somewhat skewed to the right. The mean coefficient of variation was significantly lower for non-central cities than for central cities and further analysis was confined to the 163 central cities.

When the coefficients of variation were mapped, regional differentiation of values was evident. An extensive area of the Southeast and a smaller sector in New England had the highest coefficients of variation, while the lowest values were in the West and Northwest and especially in the Great Lakes area. The steepest gradients were found in ascent to the two centers of high coefficients of variation and in a belt from central Illinois to central Ohio.

In the latter part of the study, variance analysis, total correlation and regression, and multiple correlations and regression were employed in an attempt to "account for" these patterns in describing the association with other urban phenomena which also differ areally. Significant association with the coefficients of variation was found to exist in the cases of a number of urban population and housing characteristics, of which the more important apparently were the percentage of families and unrelated individuals with less the $2,000 income (a moderately high, direct association), and the percentage of dwelling units owner occupied (a moderate, negative association).

A multiple correlation equation was derived which "explained" 67 percent of the variation in the coefficients of variation in terms of the income and owner occupancy characteristics considered simultaneously. Coefficients of variation estimated for non-central cities on the basis of this equation were found to be significantly less associated with the actual values than in the case of central cities. This reinforced the thesis that central and non-central cities are basically different. Also noted was the persistent direct association of high degrees of intraurban variation of housing costs with sub-standardness and other unfavorable urban conditions.

A number of "accuracy of estimate" maps, presented in conjunction with the correlation analysis, were interpreted as suggesting that correlation analysis on a regional basis would yield results substantially improved over the national measure. Additional suggestions for further research are contained in the final chapter, together with a summary of conclusions and a brief evaluation of the study.

Microfilm $2.50; Xerox $7.40. 156 pages.

COLUMBUS, OHIO: THE INDUSTRIAL EVOLUTION OF A COMMERCIAL CENTER.

(L. C. Card No. Mic 59-5361)

Henry Louis Hunker, Ph.D.
The Ohio State University, 1953

Introduction

The geographer, the industrialist, and the civic planner are constantly seeking to learn more about the forces which influence the location of industry. That is the principal purpose of the dissertation.

Columbus, Ohio, has experienced increased industrialization within the past 15 years. It has evolved from a city of dominantly commercial character to one that is fast becoming an important manufacturing city. Located within the loosely defined "American Manufacturing Belt," it has received the attention, recently, of national industries, and through an active Chamber of Commerce and established city and county planning commissions it has sought new industry.

Because it is a city in transition in the heart of the "Manufacturing Belt," Columbus provides the geographer with an opportunity for a thorough study of the location factors. This study of the industrial evolution of a commercial center has the following objectives: (1) to trace the industrial evolution of the city, and by so doing to learn what factors affected industrialization in earlier periods, (2) to study the present industrial complex to better understand the characteristics of Columbus' industry, and (3) to analyze and evaluate the principal forces responsible for the present location of manufacturing plants in the city, thereby drawing some conclusions about the forces which have been responsible for their location.

Commercial Columbus, 1812-1940

Columbus was the first planned state capital in the United States. Its location was chosen primarily because of the geographical position of the site, near the center of the state. Out of the forest, in 1812, Columbus was founded.

The city grew at a slow rate until 1830, and its few handicraft industries were limited to the immediate environment by an inadequate intraregional transportation system. After 1830, however, the National Road, the Ohio River, and the Erie Canal gave the city greater accessibility. Population rose, and the city prospered. A few more industries developed, in large part because of the accessibility of materials and markets. Commerce remained the dominant activity, however.

There were specific handicaps to the city's growth as an industrial center. An absence of any raw materials other than those of the farm and forest limited the types of manufacturing that could be undertaken. Power was insufficient for all but the smallest shops. Markets were poorly developed, even in the local area. Transportation did not encourage industry; it was geared to the needs of the farmer. Capital was conservative and frequently opposed to the coming of new industry. While there was an abundant supply of semi skilled and unskilled labor in the city, Columbus suffered from the absence of skilled craftsmen and of men with an inventive turn of mind. The Ohio Penitentiary hindered the growth of industry, too, by

its system of contract labor which benefited a few concerns but handicapped free labor and other manufacturers.

Thus, by 1870, Columbus remained a city of small manufacturers with no particular industry dominant. Very few Columbus products reached a national market. Commercial activities, resulting from the agricultural productivity of the Scioto Valley, were strong and overshadowed manufacturing. It was not until the interregional railroads penetrated the mineral rich counties of southeastern Ohio that Columbus began to develop a new industrial system.

The prime reason for the rejuvenation of industry after 1870 was the increased railroad activity, which brought the city into contact with the coal, iron ore, and timber resources of southeastern Ohio. It was the first time local manufacturers were able to draw upon native raw materials. Paralleling this, the geographical position of the city was enhanced by the westward-moving market.

Columbus did not gain the heavy steel industry it anticipated, but three types of industries did develop here. There were those geared to the local market, those based upon the contemporary transportation systems, and those that were established to utilize the raw materials of the southeast.

By the turn of the century, Columbus had displayed a growing industrial maturity. It had increased its national reputation even though it remained a minor manufacturing center.

The impetus given to industry by the new railroads and the utilization of the raw materials of southeastern Ohio was missing after the beginning of the twentieth century. Gradually, however, the city began to attract new industry based upon one of three forces. The transportation revolution, which resulted in a change from the carriage to the automobile, struck Columbus because of the city's position with respect to raw materials and markets. A stable and reliable low-wage labor force became a factor in the location of industry. Many low-wage industries came here at this time to enjoy labor that was free from the competition of other industries and of unions. Finally, the influence of the Federal Government was a vital force in bringing industry to Columbus. The industrialization that occurred between 1900 and 1940 can be attributed, primarily, to one of these three forces.

From the depressions, wars, and boom periods that occurred between 1900 and 1952, Columbus emerged relatively unscathed. The depressions have had a lesser effect on Columbus than other communities because of the diversity of interests in the community. Commercial activities remained strong, and industry was highly diversified. World War I meant little to Columbus, but World War II may be the actual cause of the industrial evolution that has occurred.

In 1941, the Federal Government built a huge aircraft plant in the city. Other contracts awarded to local industry increased manufacturing activity. Labor was attracted here as never before, and, possibly for the first time, Columbus began to draw large national industries. By 1952, 20 per cent of the city's manufacturing plants and more than 50 per cent of the working force were controlled by outside interests. At the end of the wartime period, industry assumed a far more important position in the city's economy.

Columbus, 1953

To better understand the characteristics of Columbus' industry, the writer made a detailed study of 220 manufacturing plants. As a result of the personal interviews that were held, it was possible to consider the forces that influenced the location of industry in the city. First, each manufacturing plant's development was reviewed. Then, the separate companies were grouped by product or by function into one of 20 industrial groups. In a detailed account of each major industry-group, the evolution of the industry is discussed, its present pattern is noted, and the forces which determined the location of this industry in Columbus are emphasized. From this detailed study of industrial Columbus in 1953, some definite conclusions can be made regarding the role of the various forces in the location of industry in the past and at present, and the future development of Columbus' industry.

Conclusions of the Study

It took the emergency of World War II to bring the city's location to the attention of national industry. The attention then focused upon the city was not the result of its position alone but partly of the availability of labor in this area. Spearheaded by the federal government's selection of Columbus as the site for a large aircraft plant, the movement of branch plants to the city was under way.

Between 1939 and 1947, the city experienced a 67 per cent increase in the number of production workers; this was a larger percentage increase than that recorded for the nation, state, or central Ohio region. This growth is expected to continue; a population of approximately 625,000 is anticipated for Metropolitan Columbus by 1960.

The timing has been right for the industrial evolution of the city. Spurred on by the war and by the shifting market in the nation, Columbus assumed new stature as an industrial center.

There are certain characteristics that typify industry in Columbus. No single one is unique, but in combination they give a special quality to the industrial community.

Manufacturing in Columbus is diversified; no single industry has dominated the city. Consequently, Columbus has remained a relatively stable industrial community. There has been a freedom from competition for workers, with the result that wages are low and union activity is limited.

The lack of inventive genius and the late start into industry are responsible for the absence of prestige items in manufacturing. There is little attachment between the city and its plants in so far as product is concerned. Columbus cannot hold specific industries or attract others in the same field. It is an element at once of weakness and of strength.

Another characteristic of Columbus' industry that has influenced the location of industry is the preponderance of locally initiated plants: they have dominated the city until recently. This has stabilized payrolls, but it may also have discouraged new industry. The situation is changing, however, with approximately 20 per cent of the manufacturing plants in Columbus now branch plants of national firms.

The industry that has typified Columbus is such that it does not beget or attract other manufacturing. This can be traced to the diversity of activity in the city. Because of this, almost no linkage or integration occurs. The importance of linkage and integration will increase with the development of branch plants. Ties between local and national organizations will be strengthened.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The commercial character of Columbus has given it no particular manufacturing activities. It is apparent that manufacturing in a commercial center differs in no important way from manufacturing in any other city.

The labor force has changed in quality as the city has undergone its transition. It had often been said that one of the principal advantages of a Columbus location was the fact that the city stood alone in central Ohio and therefore experienced little competition for labor. This has been true, and it is one of the major reasons for the growing interest of national companies in this location.

This advantage is naturally diminishing with continuing industrialization. Labor is relatively scarce within the city, and competition with other areas has increased. Labor-oriented industries are experiencing a great change. One of the principal attractions to the shoe, textile, and casket companies was the low-wage labor available here. The low wages and the absence of competition are conditions that no longer prevail.

The shoe and textile firms have been the first to give concrete evidence of this change. These low-wage, non-union companies have been forced to abandon their Columbus sites because of the recent influx of high-wage competitive plants. Columbus' reputation as a low-wage city is declining. It would seem that a continued loss of labor-sensitive plants could be anticipated in the future.

In general, Columbus' industry remains stable. The conservatism of local capital is being offset by the location of national plants in the area. The rapid growth of the past 15 years should continue into the immediate future. There is every reason for optimism concerning Columbus' industrial future.

Microfilm $3.75; Xerox $12.60. 290 pages.

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A NORMATIVE MODEL OF TRADE AREAS AND TRANSPORTATION: WITH SPECIAL REFERENCE TO HIGHWAYS AND PHYSICIANS' SERVICES.

(L. C. Card No. Mic 59-5469)

Richard Leland Morrill, Ph.D.
University of Washington, 1959

Chairman: William L. Garrison

This study concerns the impact of changes in highways on the distribution and utilization of physicians, the size and shape of their service areas and the movement of persons to physicians. The theoretical basis for such an analysis is set forth in a discussion of service areas and the underlying basis for movement or trade. Highway induced changes in service areas are given special attention. Contradictory forces of centralization and decentralization are discussed in terms of expected effects of the Interstate Highway System.

Possible methods of analysis were reviewed. Accounting procedures and gravity models were rejected as inadequate for the present study. Various transportation models, which provide a means for the assignment of trade among areas, were differentiated. A normative model, spatial price equilibrium, was decided upon, since it determines regional consumption and trade levels as well as efficient trading patterns. A linear programming formulation, which includes a set of equations for the allocation of benefits to areas, producers and consumers, was developed.

The example service, physician care, was analyzed as to the role of highways and automobiles in changing the geography of medical practice. Empirical work on the utilization of medical care was reviewed. These studies concerned the demand for medical care, the distribution and supply of physicians, the urban concentration of physicians and distances traveled for physician care.

Several special analyses pertaining to physician care were made. Demand conditions for physician care were found by regression analysis to depend largely on income and population. A survey of physician income, related to physician supplies, indicated a striking non-optimality in physician location. However, a study of changes in the location of physicians between 1947 and 1957 in Cedar Rapids, Iowa, and Seattle, Washington, indicated that physicians were gradually adjusting to changed conditions although at a lag. Increasingly, physicians were found to be moving to outlying shopping centers. A study of intercounty movement to physicians in Western Pennsylvania considered the influence of Pittsburgh, the Turnpike, and other conditions. A survey was conducted of trips to Seattle physicians, in which differences in movement patterns between general practitioners and specialists and between downtown and outlying locations were analyzed.

The model of trade was then applied to specific situations, subject to certain modifications of the usual model. A nine-region example estimated interregional movements in the United States for 1950 and 1956. Here the differences in movements reflected the impact of changed distribution of physicians. For 1950 the benefits of interregional movement were estimated. Findings were that surplus areas gain as physicians become more fully employed, and consumers avoid excess expenditures, while deficit areas lose income to surplus areas, but their consumers receive more care.

An intercounty trade solution for Western Pennsylvania was found and was related to empirical observations. The effect of highway construction was found to be increased movement from deficit areas served by the highways to surplus centers on the highway. Service areas were enlarged, unit transport costs were reduced, but total movement increased. It would seem also that the economic difference between rural and urban areas was aggravated.

Seattle provided an urban setting for the model. The trade solution determined a set of overlapping service areas, which indicates a non-optimal physician distribution. The construction of a freeway shortens time-cost, benefits certain areas and forces a realignment of prices and service areas. In this case benefits are realized mostly as consumer transport cost savings. Several deficiencies are discussed: people are unable to distinguish small cost or price differences; regional boundaries are partly unrealistic.

The significance of the method to geographic research is outlined: as a contribution to theory and as a tool for the analysis of specific problems.

Microfilm $2.50; Xerox $7.40. 156 pages.

IDIOGRAPHIC AND NOMOTHETIC GEOGRAPHY. THE APPLICATION OF SOME IDEAS IN THE PHILOSOPHY OF HISTORY AND SCIENCE TO GEOGRAPHIC METHODOLOGY.

(L. C. Card No. Mic 59-5484)

William Richard Siddall, Ph.D.
University of Washington, 1959

Chairman: Edward L. Ullman

A small but growing number of geographers are suggesting today that geography become more scientific. These scholars believe that geographers have neglected to make satisfactory use of the newest techniques available to scientists, that they should structure their problems more carefully, that there should be more training in mathematics and statistics and other tools of modern science.

It is certainly true that geographers have neglected to take full advantage of all of these tools and methods, and considering the success which the strictly controlled scientific method has had in other disciplines, including the social sciences, it would seem that geographers should act upon the suggestion that geography become more scientific.

Yet a closer examination of the problem reveals that it is not as simple as the "scientific school" would suggest. Scholars have long believed that there are two ways of examining the world, the idiographic way and the nomothetic way. A nomothetic approach may be defined as one in which the avowed purpose is the discovery of laws. Most of the social sciences, particularly economics and sociology, are considered primarily nomothetic, however immature their attempts to find laws may be at present. An idiographic approach is one in which primary attention is directed toward individual events or situations. A scholar in a primarily idiographic discipline assumes and uses laws to gain an understanding of the particular event, but he does not consider it his task to discover such laws. History is a notable example of an idiographic discipline.

A strictly "scientific school" would be clearly acting under the assumption that geography should be a nomothetic science. Careful study of the matter, however, suggests that geography (at least human geography) has been more nearly idiographic in nature in past years, although perhaps few geographers have thought of the field in these terms. Hence the "scientific school" is not simply suggesting an improvement in geography, but actually a basic change in the nature of the discipline.

Whether such a change is called for is a complex question. However, consideration of the work done in the philosophy of history is most helpful. History, during the second half of the nineteenth century, attempted to become strictly "objective" and "scientific." The results, in these terms, were not impressive, and this concept of history came under increasingly heavy attack in the twentieth century. Today all but a few historians agree that history is idiographic, that it does not seek universal laws, and that some degree of subjectivity is unavoidable. Many of the arguments which have engaged the attention of historians during this period are particularly applicable to geography today.

If geography is to remain a primarily idiographic discipline geographers must face the question of why geography is not now a stronger discipline than it is. Although some might argue that geography is not as strong as it might be because it has not become scientific enough in its methods, others might argue that the trouble lies in a number of other reasons including especially the great diversity of opinions among geographers as to what geography is trying to accomplish, and the rather severe unbalance in favor of the natural environment.

If, on the other hand, geography is to be developed as a primarily nomothetic discipline or a discipline combining with more-or-less equal emphasis the nomothetic and idiographic goals then one must determine why these approaches have not worked in history and whether they hold any more promise for geography.

Microfilm $2.50; Xerox $7.00. 148 pages.

FOREST LAND UTILIZATION IN WESTERN PUERTO RICO

(L. C. Card No. Mic 59-6184)

Joseph Andrew Tosi, Jr., Ph.D.
Clark University, 1959

Supervisor: S. Van Valkenburg

Forests and arboreal biotypes are believed to hold great promise as mediums for the more effective agrarian utilization of those inherently poor natural environments which prevail over many of the world's underdeveloped tropical regions. Prerequisite to orientation of specific researches or the rational planning of programs for land resource development is a much more precise conceptual and practical knowledge of human experience with arboreal vegetation in fully occupied tropical settings. Favorable conditions for critical inquiry into this topic are found in the western half of Puerto Rico. This densely populated, tropical island community, newly embarked upon an ambitious program for planned development of all its natural and human resources, sponsored this study there under its Rural Land Classification Program.

Field work centered upon detailed mapping of actual land-use and land capability, observations on the vegetational character of forested and wooded lands, and interviewing of land operators. Supporting information is drawn from numerous official sources. After developing a universal, functional classification of forested and wooded land-use types, current ecological and land use theory is critically examined as a basis for working hypotheses on the man-land relations. Study first established just where, how, and to what degree specified types of forested and wooded lands are distributed over the study area. Employing a systematic approach, comparative geographic analyses were then undertaken -- at progressively larger scales-of-observation -- to determine significant areal relationships between natural factors, site-quality for plant culture, and cultural landscape organization. Using map overlay and map-statistical comparison techniques, the distribution of each land-use under study was related to parameters of climatic, geomorphic, and edaphic variability in the environmental continuum. Although significant partial correlations were established, it was found that no specific land-use

distribution is ever perfectly correlated with natural factors alone.

That modifying variables of a cultural nature might be distinguished from the purely biophysical-economic, the study area was divided into its most evident natural subregions along geomorphic and edaphic lines. Within each, salient climatic, physiographic, and biotic-edaphic features were studied for their integral relation to present conditions of demography, rural occupance, transport, landholding, agrarian economic activity, and forest land-uses. Significant differences in the mode and suitability of the human adjustment to inherent productivity and operability of sites over the local environmental gradient were disclosed and compared at the subregional level. In areas of predominantly good agricultural quality, that adjustment was found to be satisfactory or better; in areas of generally poor quality -- which predominate areally -- the reverse was usually true.

Throughout the poorer subregions, there is a visibly great over-extension of agriculture and grazing onto lands biophysically adapted to permanent forestland use only. Despite native development and practice of special techniques based upon forest influences and biotypes, as shaded-coffee growing and bush-fallowing, serious land-use maladjustments are manifest on the poorest site-aggregations nearly everywhere. Unfavorable economic consequences afflict the rural inhabitants, the soils, the vegetation of remaining forested and wooded areas, and hydrological and other forest-influenced values of broad and long-term public interest. Although they cover a significantly larger area than is commonly believed, remaining forested and wooded lands occupy sites so poor as to have limited potential productivity for the major timber products, even given sound technical management.

The fundamental cause of present conditions appears to be the presence of an excessively large rural population wholly dependent upon agriculture for a livelihood. Suggestions were made on the basis of detailed findings for the future orientation of public policy, research, and directed change in the more critically maladjusted areas.

Microfilm $6.50; Xerox $22.60. 511 pages.

AN ANALYSIS OF THE NONBASIC INDUSTRIAL DEVELOPMENT POTENTIAL OF FAIRFAX COUNTY, VIRGINIA.

(L. C. Card No. Mic 59-6185)

Harland Walter Westermann, Ph.D.
Clark University, 1959

Supervisor: Dr. Raymond E. Murphy

Continued urban growth necessitates the expansion and development of the economic base. The primary reasons for this are: (1) There must be created additional job opportunities for a growing labor force; and (2) The industrial land uses afford excellent tax revenues.

Because urban growth is a national phenomenon, all urban places are in competition for this type of development. Even at the echelon of a standard metropolitan area the various independent political units attempt self-development.

To date, the solicitation of industry has been conducted generally as an advertising campaign. Each city produces a brochure which outlines the good qualities of the region as a place for industrial location and expansion. Thus, economic development has been reduced from a logical art to sales promotion.

It is the thesis of this paper that, before a community can expect industrial development, it has the obligation to show industry that there exists and will continue an "investment opportunity." (An investment opportunity is used here to mean: (a) a market opportunity, and (b) a feasibility of production.)

The purpose of the paper is to create and test a method whereby the "investment opportunity" for any urban region can be measured in a highly quantitative fashion. The method is tested in Fairfax County, Virginia which is a partially developed suburb of Washington, D. C.

The method consists of four major steps. These are:

(1) Determine the "Crude Theoretical Development Potential."

  (a) Determine the kinds and sizes of all the various types of industrial activities which would be required to meet the study area's market requirements if there existed a state of perfect competition. This requirement is stated in terms of production workers.

  (b) Determine the existing economic base as it is represented by production workers in these categories of industry.

  (c) Determine the "Crude Theoretical Development Potential" by finding the differences which exist in each of these industrial employment categories.

(2) Determine the "Refined Theoretical Development Potential."

  (a) Determine the optimum size of production units for each of the industries now listed as a deficiency.

  (b) Determine the number of optimum sized production units required to meet the deficiencies.

This should be done for two time periods.

(3) Determine the "Industrial Site Attribute Requirements" for each of the activities continued as a deficiency.

(4) Determine the area's (Fairfax County) ability to satisfy these site requirements, and eliminate as potentials all those activities which cannot be satisfied.

This procedure appears to be satisfactory. However, it depends upon extremely detailed data. These data are not readily available in most places. In addition, an industrial site survey must accompany such a procedure; this survey must be accomplished so that it answers specific questions.

One obvious advantage to this system is that once it is established it serves as a current inventory of development possibilities.

The test, as conducted in Fairfax County, showed that a great number of nonbasic activities could be accomodated.

Furthermore, it indicated that basic activities should, in most cases, be limited to assembly-type industries.

Microfilm $2.80; Xerox $9.80. 216 pages.

ECONOMIC AND POLITICAL COOPERATION OF PAKISTAN, IRAN AND AFGHANISTAN.

(L. C. Card No. Mic 59-6186)

Kaniz Fatima Yusuf, Ph.D.
Clark University, 1959

Supervisor: S. Van Valkenburg

Current interest in the possibility of political and economic cooperation among Pakistan, Iran and Afghanistan is a product of the strains to which these individual nations are subjected by the International rivalries of the great powers. In the historical process of maintaining a balance of power between the large nations, small countries are often relegated to the status of political pawns and protectorates. The domination of the small by the large for political advantage is to be seen in the present struggle between the Soviet Union and the United States. However, the rising tide of nationalism within the three small countries under discussion makes them less willing to accept the role of protectorates. One possible way of combating the threatened loss of independence is through political and economic cooperation, which would result in a larger and a presumably stronger unit. Such a unit might better withstand outside pressures and thereby preserve the independence so necessary to the morale of small nations.

Basic to the dissertation is the concept of the core area in a state. A core is defined as a region of maximum concentration of people with correlative economic activity and homogeneity of society. The cores are generally separated by transitional zones of sparse population termed marchlands. In any one state there is usually more than one core, with the largest core dominating the other cores. In the event of two or more cores of nearly equal size and strength, a devisive rivalry may develop.

The first four chapters of the dissertation deal with the distribution, cultural and ethnic homogeneity, and the economic activity of the core areas of the three states. Due to historical migrations and invasions from the north and northeast and the physiographic pattern of deserts and mountain ranges, the cores, even within a state, have heretofore developed and acted as separate units. The application of a modern system of transportation to Pakistan, Iran and Afghanistan would greatly reduce the isolation of the cores and make feasible a cooperative union based on the common heritage of Islam.

A deterrent to an effective cooperative development is the involvement of the individual states in the struggle between great powers. Their location as a bridge to the sub-continent of India and the west places them in the front line of resistance to the Soviet Union's drive to expand, whether by direct aggression or by political and economic subversion. Because of the underdeveloped and imbalanced economic conditions within the three states, they are particularly susceptible to communist economic ideology. The United States and the Western Powers, aware of the dangers to their position inherent in the expansion of Soviet political influence to the northern tier states, are committed to a policy of aiding the ailing economies in order to strengthen their resistance to communism.

Aid from either the Western Powers or the Soviet Union tends to limit freedom of action, and the peoples of the area resent any limitation to their nationalist aspirations. Further, any cooperative steps taken under western guidance will rouse the opposition of Russia, and any steps toward cooperation under Soviet guidance will rouse the fears of the Western Powers. The states, being weak and in need of support, tend to weigh the relative advantages of being pro-Western, pro-Soviet, or neutralist, and get caught up in difficult situations. Such a condition of tension is not conducive to real cooperation.

It is the opinion of the writer that since political cooperation at this time might increase the immediate danger to their survival as nations, the first cooperative steps should be in the economic realm. The economic and the political cannot be separated, and once economic cooperation becomes an effective force, political cooperation will follow.

Successful cooperation among Pakistan, Iran and Afghanistan may not weld a bloc strong enough to resist physical aggression, but in the context of the present cold war struggle unified action would be to the definite advantage of the three countries.

Microfilm $3.05; Xerox $10.40. 234 pages.

GEOLOGY OF THE BULL VALLEY DISTRICT, WASHINGTON COUNTY, UTAH.

(L. C. Card No. Mic 59-5455)

Horace Richard Blank, Jr., Ph.D.
University of Washington, 1959

Chairman: J. Hoover Mackin

The Bull Valley district is an eruptive-tectonic complex in the eastern part of the Great Basin in south western Utah. Igneous activity began in early Tertiary time and persisted intermittently until the Recent, resulting in the emplacement of numerous hypabyssal intrusive bodies and the accumulation of an aggregate total of 9000' of volcanic deposits. A major portion of these are ignimbrites, which initially were of widespread, regional distribution, but later tended to be confined by the presence of topographic barriers.

In the older of two principal eruptive centers, quartz monzonite porphyry was concordantly emplaced along the axial portion of a Laramide anticline in early- to mid-Tertiary time, forming an elongate intrusive arch. Continued rise of the magma and rapid denudation of the oversteepened structure, probably largely effected by landsliding, resulted in failure of the roof at one end of the arch and violent eruption of great quantities of latite magma. The earliest ejecta were tuff and tuff breccia of probable nuée ardente origin, but these were quickly followed by complete disrupture of the roof and extravasation of a more liquid phase. The later deposit shows a continuous transition from latite crystal tuff at points distant from the source, through latite lava, to monzonite porphyry in the core of the intrusion. The lava and material now entrapped in the vent have microscopic textures and structures nearly identical with those of the ignimbrites, possibly as the result of rapid, turbulent distillation of volatiles from the magma during eruption. Automorphic alteration of the magma apparently occurred throughout the eruptive episode, and is closely related to the formation of iron deposits in the final stages.

The second eruptive center was the site of rhyolite intrusion in the late Tertiary. Numerous silicic stocks and plugs were emplaced concurrently with the collapse and filling of the area between the focus of this activity and the monzonite intrusive arch.

Close-spaced high angle faults, probably related to the movement of magma at depth, characterise the structure of the district and have in many cases seen repeated movement during successive eruptive episodes.

Microfilm $3.10; Xerox $10.60. 238 pages.

A COMPARISON OF PHOTOGRAMMETRIC METHODS IN GLACIER MAPPING

(L. C. Card No. Mic 59-5884)

James Boyce Case, Ph.D.
The Ohio State University, 1959

Glacier maps, used for correlating glacier variations and climatic fluctuations, have generally been prepared either by terrestrial or by aerial photogrammetric methods. A project of mapping glaciers in Alaska, undertaken by the American Geographical Society for the International Geophysical Year, utilized both aerial and terrestrial photogrammetry, thus allowing a comparison to be made between these two methods. Tests to determine the pointing accuracy, absolute accuracy, and repeatability of plotting from aerial photography both in a first-order instrument, the Wild A-7 Autograph, and in a second-order instrument, the Kelsh Plotter, and from terrestrial photography in the Wild A-7 only, were undertaken.

On the basis of experience gained from this mapping project, from correspondence or discussions with those who have prepared or used glacier maps, and from references in the literature concerning such maps, a set of specifications for glacier mapping was developed. Procedures whereby both aerial and terrestrial photogrammetric methods would meet these specifications were then established. Since the two mapping methods compare favorably with regard to accuracy if mapping is done according to the recommended procedures, the general criteria for the use of one or the other of these methods will depend on such factors as economy, adaptability to terrain, geographical location, speed of field work and plotting, and so on. A method of glacier mapping by use of aerial photography which would require little or no ground control was outlined, with the suggestion that it be made the subject of further research.

Microfilm $2.50; Xerox $4.60. 87 pages.

GEOLOGY OF ST. THOMAS AND ST. JOHN, VIRGIN ISLANDS.

(L. C. Card No. Mic 59-5168)

Thomas Wallace Donnelly, Ph.D.
Princeton University, 1959

St. Thomas and St. John, located about fifty miles east of Puerto Rico, are underlain by mildly deformed Cretaceous (and older?) volcanics and limestone, which were intruded and contact metamorphosed by dioritic plutons during late Cretaceous or early Tertiary time.

The oldest rocks of these islands are the undated volcanics of the Water Island Formation (15,000 feet

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

exposed), which consists chiefly of keratophyre flows and tuffs, with minor spilite flows and rare radiolarites. Terrigenous sediments are absent. Keratophyres and spilites have the mineralogy of greenschists (quartz, albite, chlorite, epidote, prehnite, calcite, and micas) except that the albite is frequently of the intermediate-temperature form. This mineralogy is considered to have resulted from extrusion on the ocean floor, with about 500 bars of confining water pressure at the orifice retarding the separation of volatiles until low temperatures of extrusion had been attained.

Overlying the Water Island Formation with a mild angular unconformity is the Virgin Island Group, of Cenomanian age. The Louisenhoj Formation (13,000 feet maximum thickness) is the lowest unit in this group and consists of augite andesite breccias and tuffs with intercalated conglomerates (Cabes Point Conglomerate lithofacies) containing pebbles and cobbles of the Water Island Formation. The eruptive center during Louisenhoj time was probably located in Pillsbury Sound. In western St. John and eastern St. Thomas, this formation consists of coarse cone debris, derived largely by gravitational sliding from a small, sub-aerial cone. In central St. Thomas pyroclastics, frequently showing laminar slumping, are found. In western St. Thomas and on Culebra unslumped pyroclastics predominate.

Overlying the Louisenhoj Formation is the Outer Brass Limestone (200-600 feet), which consists of thin-bedded, graphitic, silicified, radiolarian limestone, with a small amount of included tuffaceous material.

The Tutu Formation (6,000 feet exposed), the next overlying unit, is a relatively coarse volcanic wacke, composed almost entirely of unweathered Louisenhoj debris, with minor admixed limestone debris. The Coki Point Megabreccia lithofacies is an intercalated slumped mass of andesite and limestone blocks, which have a neritic fauna of corals, gastropods, pelecypods (including the rudist Caprinuloidea), and echinoids, and is of apparent Cenomanian age. The Congo Cay Limestone member (300 ± 200 feet) outcrops on one island only, near the top of the Tutu Formation.

The poorly exposed Hans Lollik Formation (10,000 feet maximum) is either the youngest unit present or is equivalent to the Louisenhoj Formation (which it resembles lithologically) and is faulted into place.

Structurally, St. Thomas and St. John are a homocline, dipping to the north and cut by northwest-trending dextral and northeast-trending sinistral strike-slip faults, and north-south normal faults.

Later intrusives include diorite plutons (with minor acid differentiates), quartz-andesine porphyries, andesine-hornblende porphyries, lamprophyres, breccia dikes, and a pegmatite. The plutons preceded the major faulting, but the minor dikes followed faulting and were commonly emplaced along fractures parallel to faults.

Contact metamorphic rocks of the hornblende hornfels facies are found adjacent to larger plutons. Hydrothermal alteration followed the intrusions and resulted in silicification and sericitization, with introduction of potash.

Keratophyre magma is considered to be a low-melting fraction of ultramafic mantle material, carried to depth during convective overturn. Spilite is more completely fused mantle material and is chemically similar to augite andesite, differing only in a slightly higher alkali content. The differences in mineralogy between these two types is the result of difference in the environment of extrusion: whereas spilites are extruded on the deep sea floor, where high water pressure delays separation of volatiles until relatively low temperatures are reached, andesites are extruded subaerially, and crystallize below the orifice after the volatiles separated from the magma at depth.

Microfilm $3.40; Xerox $11.60. 262 pages.

THE BEDROCK GEOLOGY AND PETROLOGY OF THE JUNEAU ICE FIELD AREA, SOUTHEASTERN ALASKA.

(L. C. Card No. Mic 59-5461)

Robert B. Forbes, Ph.D.
University of Washington, 1959

Chairman: Dr. Peter Misch

Near Juneau, the Coast Range batholith is bordered on the west by a sequence of progressively metamorphosed rocks. The sequence has a northwesterly trend and is sub-isoclinally folded and overturned to the southwest; consequently schistosity dips to the northeast. Schistosity is mainly parallel to compositional layering, but divergence occurs in the axial zones of major folds. The grade of progressive regional metamorphism increases northeastward across the strike, including mineral assemblages of low, medium and high grades.

A wide variance in composition of the alternating rock units permits the comparative study of metamorphic zonation and facies in basic volcanic, argillaceous and impure calcareous - dolomitic rocks under conditions of progressive synkinematic metamorphism.

Zones are clearly defined in the alumina-excess rocks, which are similar to the zonation of the Grampian Highlands described in the classic works of Barrow and Tilley. The zonal distribution of index minerals in the Ca-Mg rich rocks reconfirms the reliability of Barrovian zonation in the pelitic schists.

Plagioclase shows a systematic increase in anorthite content with rising metamorphic grade.

The westernmost migmatitic gneisses occur as rare gradational intercalations in the medium grade pelitic schists and amphibolites. The quartz dioritic migmatitic gneisses of the West Marginal Belt display a schistosity defined by aligned relict mafics inherited from the parent rocks. The gneiss layers grade delicately into adjacent schists and amphibolites. Schistosity and compositional layering in the migmatitic gneiss intercalations and the adjacent host rocks is parallel. Replacement textures displayed by late sodic plagioclase, quartz and minor K feldspar indicate that the migmatitic gneisses are derived from the mixing of host rocks and metasomatically introduced Na, SiO_2 and minor K during late and post-kinematic time.

Migmatitic gneiss layers gradually increase in volume toward the northeast at the expense of transformed host rocks; and the bulk composition of the gneisses grades to granodiorite in the Central Belt, and subsequently to quartz monzonite in the boundary zone between the Central and East Marginal Belts. The compositional gradation from quartz diorite to quartz monzonite is due to a

progressive increase to the northeastward, in the amount of metasomatically introduced K. The granodioritic and quartz monzonitic migmatitic gneisses contain ill defined mobilized areas which become increasingly common to the northeastward. Locally, the mobilized gneisses have attained intrusive characteristics.

Folds in the Central and East Marginal Belts tend to become open and upright, rather than isoclinal-overturned, but local exceptions have been noted. The crystalline schists have apparently experienced two stages of folding. The earlier folds (Pre-Permian) had a westerly trend.

The easternmost quartz monzonitic migmatitic gneisses terminate in a gradational contact with a screen composed of relict schists, amphibolites and lime silicate rocks. East of the screen, the remaining part of the batholith is composed of directionless quartz monzonite and granite, here termed the east marginal pluton. The pluton is believed to be concentrically zoned, grading from quartz monzonite at the margins to granite near the center of the mass.

Near the International Boundary, the plutonic rocks are in sharp intrusive contact with Pre-Permian crystalline schists and an unconformably overlying sequence of andesitic volcanics containing interbeds of tuffaceous conglomerate and greywacke. Rocks of both sequences are locally hornfelsed above the contacts.

Microfilm $4.20; Xerox $14.20. 326 pages.

REGIONAL STRATIGRAPHY OF THE PENNSYLVANIAN SYSTEM IN NORTHEASTERN UTAH, WESTERN WYOMING, NORTHWESTERN COLORADO, AND SOUTHEASTERN IDAHO.

(L. C. Card No. Mic 59-5453)

Dallas Odell Peterson, Ph.D.
State College of Washington, 1959

Supervisor: Dr. W. Frank Scott

Pennsylvanian strata occur throughout the area of investigation and, due to various depositional environments and hence lithologic variations, nomenclatural problems exist. It is suggested that: 1) the Quadrant and Casper formational names be abandoned and the Tensleep-Amsden-Sacajawea terminology extended to include the strata formerly referred to by these names; 2) the Sacajawea be accepted as a formational name applicable to the red clastic sequence between the Madison limestone or equivalent and the Amsden carbonates; 3) the Oquirrh formation be raised to group status and carried into the Wells formation area, the Wells being dropped or retained as a formation within this new group; 4) the Round Valley limestone be accepted as a valid formational unit applicable to what was formerly known as the lower Morgan; 5) the Youghall formation be redefined as the upper member of the Morgan and restricted to the upper tan and buff sandstones and interbedded limestones of the former Youghall formation; 6) the balance of the former Youghall which is the red sandstone and interbedded limestone be designated the "Red Morgan" member; 7) the Hells Canyon formation be reduced to member status, becoming the lower member of the Morgan formation in the Uinta Mountains; 8) the formational names, Hermosa and Molas, be retained at least until the wealth of new stratigraphic data in the Paradox basin area can be adequately evaluated and made functional; 9) the Ely formation of eastern Nevada be elevated to group status to include the Pennsylvanian sequence in the entire eastern Nevada area.

Isopach and lithofacies patterns display the Uncompahgre and Front Range positive areas and their complementary sags, the Paradox and Central Colorado basins. East-west trends across the Uinta Mountain area indicate a thick accumulation of predominantly clastic shallow marine and continental sediments in an elongated trough called the Uinta trough. The Oquirrh basin and Wyoming shelf areas are clearly outlined.

The Uncompahgre Highlands appear to have extended at least as far as the Wasatch and Uinta Mountains junction based on the isopachous pattern and regional stratigraphic relationships. Projection of this structural feature beyond its heretofore recognized northwestern limit serves as a possible explanation for: 1) the absence of the Morgan south of the type area; 2) the thick Oquirrh facies on the south and west opposing the Weber-Morgan-Round Valley facies on the north and east along the line of projection; and 3) the facies change eastward in the Morgan formation.

The source of the sands deposited on the Wyoming shelf and in the Uinta trough area is believed to be positive areas situated west and northwest of the area under study. Red clastics in the Amsden and Morgan formations is believed to be the eroded and redistributed portions of the Molas and Sacajawea formations which are lithogenetic units, but not time-stratigraphic.

A complex paleogeographic picture exists due to the several very active positive and negative elements plus regional epeirogenic oscillations. By the close of the Pennsylvanian and into the lower Permian time the area was largely exposed to sub-aerial erosion with the Tensleep and Weber sands distributed by wind action. Subsequently, Permian phosphatic rich seas invaded the area, producing a marked lithologic change.

Petroleum possibilities vary throughout the area of study. The best area for exploration at the present time is in the Paradox basin. Future fields may be found in the northern part of the Paradox basin area where stratigraphic traps may occur as pinch outs up dip against the positive elements or result from changes in porosity-permeability. Similar possibilities exist in the southern part of the Uinta Basin and the transitional interface between the Uinta trough and the Central Colorado basin sediments, as well as possible stratigraphic traps westward where the sands of the Weber become tight.

Microfilm $3.40; Xerox $11.60. 263 pages.

THE GEOLOGY, MINERALOGY, AND GENESIS OF SELECTED FIRECLAYS FROM LATAH COUNTY, IDAHO.

(L. C. Card No. Mic 59-5647)

Herman Ponder, Ph.D.
University of Missouri, 1959

Supervisor: Walter D. Keller

Residual and sedimentary fireclay deposits occur in the Miocene Latah formation, Latah County, Idaho, where

they terminate against foothills of granitic (granodioritic, gneissic) masses upon which residual clay bodies have developed.

Granodiorite gneiss has altered to residual clay deposits by surface weathering in a humid temperate environment. The typical mineralogy of the residual clay is kaolin minerals (65%), quartz (20%), K-bearing micas (12%), and montmorillonite-chlorite (trace). The kaolin minerals are, in order of abundance, halloysite, endellite, and fireclay mineral.

The transported fireclays, which are fresh-water lacustrine sediments derived primarily from the residual clay deposits, have undergone essentially no alteration since deposition. These clay deposits are composed of variable but major amounts of kaolin, quartz, and K-bearing micas, accompanied by minor amounts of orthoclase and mixed-layer illite-montmorillonite and chlorite-montmorillonite. Halloysite, endellite, and fireclay mineral are the kaolin minerals, in their order of abundance.

Interbedded with the transported lacustrine fireclays are seams of clay derived from volcanic ash altered in place prior to burial. The ash-derived clay is composed almost entirely of kaolin (95%), which occurs, in order of abundance, as endellite, halloysite, allophane, and fireclay mineral. The dominant non-clay constituents of this clay are quartz (3%), tridymite (1%), sanidine (1%), and volcanic glass (<1%).

It is noteworthy that endellite, a highly hydrated kaolin mineral, has developed in two separate geologic environments: as an alteration product during surface weathering of a granodiorite gneiss, and by hydrolysis of volcanic ash in a fresh-water lacustrine environment. It is postulated that endellite is a common product of weathering.

Microfilm $2.50; Xerox $8.40. 181 pages.

BRACHIOPODA AND MOLLUSCA FROM THE BURGNER FORMATION IN SOUTHWEST MISSOURI

(L. C. Card No. Mic 59-5650)

Wendell J. Ragan, Ph.D.
University of Missouri, 1959

Supervisor: Dr. A. G. Unklesbay

Forty species representing twenty-one genera of brachiopods, seven species comprising seven genera of pelecypods, and nine species belonging to eight genera of gastropods are described and illustrated from the Burgner formation in southwestern Missouri. The brachiopods seem to be the best group for age determination and biostratigraphic correlation of these rocks. Nomenclatural problems of each species are considered under the descriptions. Eleven species of brachiopods are proposed as new.

Comparison of these brachiopods with published lists and illustrations shows some are of Morrowan and Atokan ages. Several forms appear to be restricted, or nearly so, to rocks of the latter age and are believed to provide a valid basis for assigning an Atokan age to the Burgner formation. Microfilm $3.10; Xerox $10.60. 238 pages.

SOME ASPECTS OF THE PALEONTOLOGY, STRATIGRAPHY, AND SEDIMENTATION OF THE CORRY SANDSTONE OF NORTHWESTERN PENNSYLVANIA.

(L. C. Card No. Mic 59-6073)

Daniel B. Sass, Ph.D.
University of Cincinnati, 1959

A thorough study of the fauna of the Corry sandstone of northwestern Pennsylvania is herein initiated. Species of four genera, two of the Porifera and two of the Brachiopoda, are described. Some hitherto unrecognized morphological characteristics of the Dictyospongiidae are emphasized.

Four species of the brachiopod genus Paraphorhynchus Weller (1905) are described, one of which, P. casteri is new. A new criterion of the genus is proposed in the presence of a "posterior adductor process" in the pedicle valve. Characteristics of the genus Syringothyris Winchell (1863), s.s., are evaluated; two Corry species are redescribed and compared with similar forms in the underlying Knapp formation. The species Syringothyris randalli Simpson is reassigned to the genus Syringothyris, s.s., and the genus Syringopleura Schuchert (1910), resurrected by Holland (1958), is rejected.

An attempt is made to reconstruct the former continuity of the Corry sandstone throughout its area of surface outcrop in northwestern Pennsylvania. The formation is divided into three members including: (1) a Lower sandstone member; (2) a Middle siltstone; and (3) an Upper sandstone member.

The Lower Mississippian (Kinderhookian) age of the Corry is reaffirmed. A correlation of the Lower Corry member with the upper portion of the Bedford shale of Ohio is suggested.

Microfilm $3.95; Xerox $13.40. 306 pages.

PEBBLE LITHOLOGY OF NEBRASKAN AND KANSAN TILLS IN NORTH-CENTRAL MISSOURI

(L. C. Card No. Mic 59-5653)

Lloyd John Schmaltz, Ph.D.
University of Missouri, 1959

Supervisor: Chauncey D. Holmes

The glacial drift in north-central Missouri was deposited by both Nebraskan and Kansan ice sheets. In earlier studies, lack of criteria for distinguishing Nebraskan drift from Kansan drift has represented a major problem in understanding Pleistocene history in northern Missouri.

Pebble counts within a restricted grade-size (1/4 in. to 1/2 in.) are used in this study to distinguish Nebraskan and Kansan tills. Within this grade-size the combined per cent of clastic rocks in Nebraskan till averages 42.4, as compared with 15.4 for Kansan till. Both tills contain approximately the same suite of far-travelled erratics, including abundant Sioux quartzite. This is believed to indicate ice movement from north to south or from slightly northwest to southeast for both ice sheets.

Microfilm $2.50; Xerox $5.80. 118 pages.

GEOMORPHOLOGY OF THE LOWER COASTAL PLAIN FROM THE SAVANNAH RIVER AREA, GEORGIA, TO THE ROANOKE RIVER AREA, NORTH CAROLINA.

(L. C. Card No. Mic 59-5583)

Evelyn Zepel Sinha, Ph.D.
The University of North Carolina, 1959

Supervisor: William A. White

Differences among some geomorphic features permit dividing the lower Coastal Plain into three physiographic sections. The Sea Island section lies between the Altamaha River, Georgia and the Santee River, South Carolina. The Arcuate section lies between the Santee and the Neuse River of North Carolina. The Embayed section lies between the Neuse and the James River of Virginia.

Characteristics of the transitional and marine sedimentary environments in the present shore zone serve as criteria in the recognition and interpretation of relict features as far inland as the 100 foot contour.

Systematic differences between the Sea Island and the Arcuate sections express the different response of these sections to the Wicomico and later marine transgressions. Nonsystematic differences in the Embayed section suggest that erosion following deformation has either obscured or obliterated the effects of one or more marine transgressions.

Barrier bars, barrier islands, and lagoons developed repeatedly in the transitional environments in response to the gentler slopes of the coastal plain in the Sea Island and southern Arcuate section, while beach plains and wave-cut cliffs developed on the steeper slopes of the northern Arcuate section. Characteristic soil types in the transitional environment vary from clay to clay loam; those in the marine environment are dominantly sand.

Soil types and land forms in the Embayed section vary. Sandy loam, the dominant soil of the Wicomico level, is either continental or paralic in origin. The presence of sandy loam on the Wicomico level may be the result of local deformation. The slope of the Embayed section in Wicomico or Pamlico time cannot be deduced. But the change in orientation of the coastal plain between Pamlico time and the present is indicative of significant changes in sea bottom topography. Such changes may have engendered reciprocal changes in the wave refraction pattern and the eddy current system providing the conditions for the evolution of this coastal salient.

The master streams responded individually to the marine transgressions. The Sea Island and Arcuate sections have a sub-parallel drainage pattern. Their master streams were not dismembered, but the Roanoke River, the master stream of the Embayed section, was dismembered. The Savannah River (Sea Island section) braids and a part of its load accumulates in its vicinity. The Cape Fear River meanders (northern Arcuate section) and its load is dispersed. In its lower course the Cape Fear is deflected southward by the growth of sand spits or bars. The Roanoke River has a youthful or rejuvenated meander pattern and part of its load accumulates within the transitional environment of the Embayed section.

Differences in the geomorphic features of the lower Coastal Plain between the Altamaha and James Rivers are the effects of systematic differences between the slopes of the Sea Island and Arcuate sections, but the features of the Embayed section differ because local deformation took place during or after the Wicomico marine transgression.

Microfilm $2.50; Xerox $6.80. 141 pages.

GEOLOGY OF VAN HORN MOUNTAINS, TRANS-PECOS TEXAS.

(L. C. Card No. Mic 59-6729)

Page Charles Twiss, Ph.D.
The University of Texas, 1959

Supervisor: Ronald K. DeFord

The Van Horn Mountains includes 310 square miles in southwestern Culberson, southeastern Hudspeth, and northwestern Jeff Davis Counties, Texas, lying near the eastern edge of the basin-and-range province and in the northwest part of the Davis Mountains volcanic area. The mountains, an eroded horst flanked by alluvium-filled bolsons, contain rocks of Precambrian, Permian, Cretaceous, and Tertiary age.

Three outcrops of Precambrian rocks consist largely of arkose which has been regionally metamorphosed and intruded by small pegmatite bodies. Ordovician to Pennsylvanian rocks were eroded, and the Permian redbeds of the Powwow Conglomerate were deposited on Precambrian rocks. Marine deposition on the Diablo Platform resulted in the Hueco Limestone and the dolomitized Victorio Peak Formation.

A marine transgression over truncated Permian rocks was marked by the sandstone of the Yucca and Bluff Formation in the Chihuahua Trough and the Yearwood Formation on the Diablo Platform. These units and the Cox, Finlay, Benevides, Loma Plata, Eagle Mountains, and Buda Formations belong to the Comanche Series; the flaggy limestone and shale of the Chispa Summit Formation belong to the Gulf Series. Asymmetrical folds and thrust faults formed as a result of Laramide tectonism.

Tertiary volcanic rocks from adjacent areas, some traced from south of the Wylie Mountains (east) and some from the Sierra Vieja (south) are interfingered in the Van Horns. Units of conglomerate, tuff, ignimbrite, and lava rock comprise the Colmena, Buckshot, Chambers, Hogeye, Pantera, Tuff (Ttu), and Trachyte (Ttr) Formations and Garren Group (undifferentiated). Small dikes, a stock, and a volcanic plug are at least younger than the Hogeye Tuff. Bolson deposits formed in response to late Tertiary block faulting are overlain by Quaternary pediment gravels and alluvium. Microfilm $3.55; Xerox $12.00. 274 pages.

MARINE ENVIRONMENT AND MACRO-BENTHOS OF THE WATERS OF PUGET SOUND, SAN JUAN ARCHIPELAGO, SOUTHERN GEORGIA STRAIT, AND STRAIT OF JUAN DE FUCA.

(L. C. Card No. Mic 59-5485)

Marcel Pat Wennekens, Ph.D.
University of Washington, 1959

Chairman: Richard H. Fleming

A study of interrelationships between the physical environment and the benthic communities of the waters of Puget Sound, San Juan Archipelago, southern Georgia Strait, and Strait of Juan de Fuca has been made.

The study of the benthic communities, defined in terms of the macro-benthos inhabiting waters deeper than 10 fathoms (18 meters), has been approached by first analyzing the characteristics of the physical environment and by subsequently establishing the locations of the various boundaries of the physical environment. The physical factors which have been considered are: Physical and chemical properties of the water, currents, bathymetry, and bottom sediments.

The inland waters have been considered as a deep, positive, estuary of a compound type with regions of highly stratified, slightly stratified, and vertically mixed waters, in which large tidal amplitudes and a complex bathymetry control both the distribution of water mass properties and the selective sorting of bottom sediments originating from glacial tills.

Intense turbulent mixing is generated in regions of rapid flow and rough topography. The turbulent mixing breaks down the stratification, the result being an almost homogeneous water mass which is the source water for the deep basins, maintaining an almost uniform vertical distribution of temperature and salinity.

Strong stratification, when present, is restricted to shallow surface layers, less than 20 meters deep.

The physical characteristics of the substrate upon which bottom animals dwell have been analyzed in terms of sedimentary environments which refer to a combination of the physical character of the sediments and the influence of the hydrography, mainly bottom currents, upon the sediments in situ.

The mid-channel floors have been subdivided into erosional, non-depositional, and depositional sedimentary environments. The sedimentary environments of channel slopes are shown to be non-depositional or temporary depositional, depending upon the steepness of the slopes.

The distribution of the benthic communities has been shown to depend primarily upon the character of the sedimentary environments. Several well-defined communities have been recognized: Balanus nubilis community, characterized by the large barnacle encrusting the stony and rocky bottoms subjected to strong currents and strong turbulence; Humilaria kennerlyi - Glycymeris subobsoleta community, characterized by the two pelecypods inhabiting gravel and pebble bottoms subjected to moderate to strong currents; Modiolus modiolus community, characterized by the mussel inhabiting gravelly, muddy gravel, and gravelly mud subjected to strong to moderate currents; Macoma nasuta community, characterized by the pelecypod inhabiting sandy mud subjected to moderate to low currents; Brisaster townsendi - Caudina obesacauda community, characterized by the echinoderms inhabiting the mud and clayey mud of the quieter, deep basins; Pholad - Saxicava community, characterized by the boring pelecypods inhabiting the extensive outcrops of compacted blue clay; and Pecten hericius - Pecten hindsii community, characteristic of stony to sandy mud bottoms influenced by strong to moderate currents.

The inland waters have been classified into several natural regions: Coastal, Mixed, Basin, Embayments and Inlet Heads. Each region has common hydrographic, sedimentary, and faunistic characteristics, which demonstrate the close relationship between the bottom animals and their marine environment, and emphasize the fact that the study of benthic communities cannot be divorced from a corresponding study of their physical environment.

Microfilm $4.55; Xerox $15.20. 354 pages.

HEALTH SCIENCES, PHARMACY

THE PERMEABILITY OF RED CORPUSCLES TO VARIOUS LOCAL ANESTHETICS

(L. C. Card No. Mic 59-6103)

David Marcus, Ph.D.
The University of Florida, 1959

The present investigation is concerned with the effects of various compounds in preventing hemolysis. The pharmacological group of compounds known as the local anesthetics were thought to be of considerable interest in this connection from two aspects. First, these compounds are of pharmaceutical importance and have been administered parenterally. Second, a large number of the local anesthetics are similar in structure and an opportunity to compare structure to activity would be presented. The majority of the compounds studied in this investigation had not been previously reported with reference to their effect upon erythrocytes.

The classical procedure for determining the concentration of a solute isotonic with the blood depended upon a consideration of physicochemical data. Recent investigations have disclosed that the calculation of tonicity, based solely upon colligative properties, may prove to be inaccurate when applied to the preparation of solutions isotonic with the blood. The explanation for this phenomenon lies in the fact that physicochemical calculations of isotonicity do not take into consideration the effect of the substance

upon the nature of the red cell membrane and the penetration of the substance through the membrane.

Employing the hemolytic method, 19 local anesthetics were investigated. Quantitative hemolytic determinations were conducted with both human and rabbit blood. Hemolytic i values were determined for four of these compounds; the remaining local anesthetics failed to prevent osmotic hemolysis sufficiently for the calculation of i values. The anesthetics for which i values were determinable had extremely low i values. Experiments conducted in the presence of 0.2 per cent sodium chloride revealed that the i values were depressed by the salt.

To explain the inability of the remaining local anesthetics to prevent osmotic hemolysis, experiments were performed in the presence of 0.6 per cent sodium chloride. The purpose of these determinations was to evaluate the effect of these compounds upon erythrocytes even when the salt concentration was sufficient to prevent osmotic hemolysis if no other substance were present. Hemolysis occurring in the presence of 0.6 per cent sodium chloride would therefore be due to something other than osmotic effect, possibly an alteration of the membrane in some manner. Results indicated that the local anesthetics that did not provide hemolytic i values caused hemolysis in the presence of 0.6 per cent sodium chloride.

From this investigation, it appeared that in local anesthetics of the benzoic and para-aminobenzoic ester type, the alteration or addition of groups may produce a profound effect upon their properties as regards hemolysis.

Microfilm $2.50; Xerox $7.80. 166 pages.

THE PERMEABILITY OF RED CORPUSCLES TO VARIOUS SYMPATHOMIMETIC AMINES AND PHENOTHIAZINE DERIVATIVES

(L. C. Card No. Mic 59-6116)

Edward Phillip Winters, Ph.D.
The University of Florida, 1959

It has been demonstrated by recent investigations that solutions calculated to be isotonic by physicochemical data are not necessarily isotonic when in contact with blood. The intent of the present investigation was to obtain further data which might be of value in the preparation of solutions intended for injection by employing sympathomimetic amine compounds and phenothiazine derivatives.

With increasing concentrations of solution, hemolysis of red blood cells was prevented to a greater extent by amphetamine sulfate, dextro amphetamine sulfate and hydroxyamphetamine hydrobromide than with solutions of mephentermine sulfate, methoxyphenamine hydrochloride and phenmetrazine hydrochloride. Hemolysis caused by these compounds usually decreased, increased, decreased and increased again in contrast to the usual gradual decrease in hemolysis caused by increasing concentrations of compounds tested by other investigators.

Hemolysis was usually greater than 80 per cent in all concentrations of methoxyphenamine hydrochloride tested, more than 20 per cent in all concentrations of mephentermine sulfate used and more than 49 per cent in all concentrations of phenmetrazine hydrochloride employed.

In the presence of 0.6 per cent sodium chloride, hemolysis did not occur in solutions of the sympathomimetic amine compounds until a concentration was reached in solutions of amphetamine sulfate, mephentermine sulfate, methoxyphenamine hydrochloride and phenmetrazine hydrochloride which closely coincided with the same concentrations of these compounds without sodium chloride that caused the final upswing in the hemolysis curves. Both the d and dl forms of amphetamine sulfate apparently exerted the same action on erythrocytes.

Determination of pH values before and after the addition of human blood and reactions with oxyhemoglobin and serum indicated the acceptability of the sympathomimetic amine compounds for testing by the hemolytic method.

Phenothiazine derivatives employed could not be tested by the hemolytic method due to their apparent incompatibility with blood.

Microfilm $2.50; Xerox $6.60. 137 pages.

HEALTH SCIENCES, PUBLIC HEALTH

CRITERIA FOR FIELD TRAINING OF HEALTH EDUCATION STUDENTS FORMULATED FROM AN INVESTIGATION OF FIELD TRAINING EXPERIENCES OF SELECTED STUDENTS FROM TWO NORTH CAROLINA COLLEGES

(L. C. Card No. Mic 59-5589)

Hiawatha B. Walker, Ph.D.
The University of North Carolina, 1959

Supervisor: Lucy S. Morgan

A study was made of selected phases of the experience of the Departments of Public Health Education of North Carolina College and the University of North Carolina. These schools have routinely required supervised field experience for all graduate students in health education.

All participating centers from the beginning of programs at both schools through 1952 were considered. Health departments serving populations of 75,000 or more demonstrated better continuity.

The schools had circulated questionnaires for the period 1948-1952, inquiring concerning staffing, supplies and equipment, and contemplated program activities. Comparisons of estimated staff-population ratios with recommended standards revealed participating departments understaffed for health officers, nurses and health educators, but adequately staffed for sanitation and clerical personnel. Most departments had the basic supplies and equipment required for health education and anticipated program activities of training value.

The investigator developed for field training reports a rating scale based on the 1948 Functions of Health Education and seven criteria for field experiences. Application of the scale to a preliminary group of forty and a final study group of sixty-four field reports, revealed marked differences in levels of involvement both between and within the sixteen areas of activity.

Computation of weighting values, by multiple regression, for scores from the preliminary group of field

reports produced statistically significant relationships with academic grades for these areas of activity: preparation of materials, survey and orientation, coordination of agencies, community organization, and work with study groups. Negative relationships were obtained between academic grades and student involvement in pre-service training, interpretation of objectives and services, and budgets. The weighting values were applied to the final study group and those findings were evaluated by correlation with academic grades.

Preliminary criteria for selection of field centers were formulated for staff-population ratios, professional training of key staff members, the presence of program activities including emphasis on those areas having statistically significant relationships to grades and to strengthening areas receiving little emphasis.

Seven criteria for evaluating field experiences were:

1. the health educator and agency staff did the necessary preliminary planning so that the various aspects of the agency's program would provide rich and meaningful learning experiences, considering both quality and scope;
2. the field experiences provided were sufficiently complete to enable the student to function as a first level health educator;
3. the level of experiences provided was comparable to that of a typical health educator in a typical work situation;
4. the experiences began where the people were and proceeded in an orderly manner toward definite goals;
5. there was apparent awareness of long-range goals by health education personnel, even though others may have been preoccupied with minor and short-range goals;
6. normal progress was made toward recognizing goals, considering the level of understanding of the people involved and time limitations inherent within the situation;
7. the learning situation emphasized development of a working philosophy of health education and not just the learning of various techniques supposed to get desired results.

Microfilm $3.30; Xerox $11.20. 255 pages.

METHODOLOGY IN THE ANALYSIS OF PERINATAL MORTALITY - THE PERINATAL MORTALITY EXPERIENCE IN THREE TEACHING HOSPITALS IN NORTH CAROLINA.

(L. C. Card No. Mic 59-5592)

Henry Bradley Wells, Ph.D.
The University of North Carolina, 1959

Supervisor: B. G. Greenberg

Medical, biological, and social factors from a pilot study of perinatal mortality are analyzed by several different methods in order to determine which one(s) to recommend for routine use in the analysis of causal and associative relationships in perinatal mortality. The methods used give different results possibly because of differences in underlying mathematical models and varying amounts of efficiency in analysis.

Discriminant analysis and regression analysis are recommended as the methods of choice. These two additive linear models seem best to satisfy intuitive notions of how the multitude of factors interact in causing a perinatal death. In addition, the results obtained by using these models are reasonably consistent with each other and with current obstetric knowledge.

Based upon these methods of analysis, the social and biological factors are not significant when the incidence of medical complications of pregnancy, labor, and delivery are held constant. Birth weight and length of gestation are consistently highly significant in determining outcome. The obstetric complications of pregnancy, labor, and delivery are highly lethal factors.

It is concluded that further research into the etiology of these obstetric problems and of both birth weight and length of gestation can be done by the two recommended methods while taking into account the many variables which influence perinatal mortality.

Microfilm $2.50; Xerox $7.40. 157 pages.

HISTORY

HISTORY, GENERAL

REINHOLD NIEBUHR'S SEARCH FOR SOCIAL JUSTICE

(L. C. Card No. Mic 59-3141)

Ernest F. Dibble, Ph.D.
The American University, 1959

Reinhold Niebuhr's writings reflect his concern with the social, political and religious problems of his times. A great many themes have existed in his writings at one time or another. However, certain fundamental concerns have remained steadfast throughout his adult life. The search for social justice has been both a fundamental and a steadfast concern from the time he first revealed his thought in print to the end of World War II.

Niebuhr's search for social justice is revealed in this dissertation as a unifying theme in the development of his thought. It is revealed in his anti-puritan attack upon middle class society and in his Social Gospel hopes for social justice during the 1920's. In the early Depression years the social justice quest was buttressed by use of insights from a "sentimental Marxism," which made up

for deficiencies in the Christian ethic of love. In the face of developing fascism Niebuhr could not rest content with this Christian-Marxian definition of social justice. Therefore he searched more deeply within Christian myths, and found a basis for defining man's responsibility to man through a more profound definition of man's relation to God. The more profound myths in this respect were the ones that liberal Christianity and liberal society had rejected. In the late 1930's and early 1940's the search for social justice was abetted, but obscured, by paying more attention to myths of both the Beginning and the End, and by adopting a more existential dialectic. Since the end of World War II Niebuhr has followed in the tradition of St. Augustine and St. Thomas Aquinas, by preparing a religious defense of the concept of "just war."

The above analysis of Niebuhr's thought is based primarily upon his magazine articles, especially for the earlier period of time when it was most important to do so. This is neither a topical nor a biographical study. It is a study, concentrating upon narration and internal analysis, which shows how the search for social justice so evident in Niebuhr's earlier thought remained a steadfast concern, despite its interaction with the new political and religious themes of later decades.

Microfilm $3.00; Xerox $10.20. 230 pages.

THE PUBLIC CAREER OF JOHN LOUIS O'SULLIVAN

(L. C. Card No. Mic 58-3227)

Sheldon Howard Harris, Ph.D.
Columbia University, 1958

Manifest Destiny, a slogan used by many Americans to justify territorial expansion in the mid-1840's, was coined in 1845 by John Louis O'Sullivan. Heretofore, this phrase has been O'Sullivan's chief claim to fame. Careful investigation of O'Sullivan's career indicates, however, that there were other facets in his career which were even more noteworthy.

O'Sullivan, who was born in November, 1813, compiled a brilliant undergraduate record at Columbia College. He abandoned a promising teaching career, in 1835, in order to enter the American literary and political scene. With his brother-in-law, Samuel Langtree, he founded The United States Magazine and Democratic Review, in Washington, in 1837. The Democratic Review combined literary excellence with strong Democratic party partisanship in its editorial pages. It soon became the leading Democratic magazine in the country, and from 1841 to 1846, under O'Sullivan's exclusive editorial control, it rose to literary greatness. Hawthorne, Bryant, Whittier and Simms were regularly featured; Whitman, Poe, Cooper, Lowell, Thoreau and Emerson were occasional contributors.

A strong supporter of Martin Van Buren and of the radical wing of the Democracy, O'Sullivan served in the New York Assembly in 1841 and 1842. He introduced a series of reform measures which reflected the entire radical Democratic program. His most important bill was a proposal to abolish capital punishment in New York. This measure, as almost all of his other proposals, was defeated, but he did make a name for himself in local politics.

O'Sullivan played an important role in the campaign of 1844. In August, 1844, he and Samuel J. Tilden established the New York Morning News. The News rapidly became the leading Democratic journal in New York City, and it set the lead for other Democratic newspapers in the state. Basing their campaign on the old Jacksonian issues, and underplaying the expansionist propensities of James K. Polk, the editor's shrewd strategy was successful: Polk carried New York state in the election.

Cristobal Madan, O'Sullivan's brother-in-law, brought him, in late 1846, into the Cuban annexation movement. O'Sullivan convinced the Polk administration of the desirability of purchasing Cuba from Spain, and Polk made serious efforts, in 1848, to effect this aim. Later, O'Sullivan joined the Cuban revolutionary exile, Narciso López, in planning filibustering expeditions to the Island. O'Sullivan was tried for these activities, but a jury failed to bring in a verdict.

In 1854, the Pierce administration awarded O'Sullivan an appointment as chargé to Portugal. He served the United States creditably in this capacity for four years. His duties were not difficult, but he did help improve American-Portuguese relations.

Upon the outbreak of the American Civil War, O'Sullivan joined the Confederate cause. Although he was a member of the Free Soil party in 1848 (solely for the purpose of defeating Lewis Cass, the Democratic party candidate), he was an ardent advocate of Negro slavery. His contributions to the Confederacy were mainly in the propaganda field, and in Europe he published a number of pamphlets upholding the Southern position. He was also active in trying to obtain iron-clads from Sweden for the Confederate navy. Lee's surrender in 1865 brought O'Sullivan's public career to an end.

The brilliant, capable, personable, but unstable, John Louis O'Sullivan, was a leading spokesman for the radical wing of the Democratic party from 1837 to 1854. He was an important political figure during the Van Buren, Polk and Pierce administrations. His great failure was his inability to recognize the basic inconsistency between his enthusiastic support for the advancement of the rights of the white common man, and his equally ardent defense of Negro slavery. However, as editor of the Democratic Review, he did make a significant contribution to American literature in the pre-Civil War period.

Microfilm $5.60; Xerox $19.60. 439 pages.

THE LIFE OF CHARLES GRANDISON FINNEY

(L. C. Card No. Mic 59-6306)

James E. Johnson, Ph.D.
Syracuse University, 1959

Supervisor: Nelson M. Blake

The purpose of this study is to examine in detail the life of Charles Grandison Finney, nineteenth century evangelist and educator. An attempt is made to place Finney within the context of his times, and to evaluate his activities as an evangelist, scholar, reformer, and author.

Indispensable sources have been the Charles Grandison Finney Papers at Oberlin College Library. In addition to

these, other manuscripts, pamphlet material, the Oberlin Evangelist, New York Evangelist, and personal accounts of contemporaries were useful. No published biography of Finney has gone much beyond the description by himself in his Memoirs.

Charles Grandison Finney was born in 1792 in Warren, Connecticut, but his parents followed the prevailing tide of migration into central New York State soon after his birth. Young Finney grew up amidst frontier conditions, enjoying an apparently normal boyhood. With little evidence of any religious influence in his family background, with conversion coming at the age of 31 when he was settled into a law practice, with little formal training for the ministry, and with no indication that he would do well but a driving conviction that he had a "retainer from the Lord Jesus Christ," he made his mark on his generation as few men have before or since.

The Finney revivals began in the little towns of Evans Mills, de Kalb, and Gouverneur in northern New York. This was a frontier region, and the novice preacher was almost as crude as the congregations he preached to. In the years 1825 and 1826 Finney advanced into Oneida County in central New York. His audiences were larger and his methods more polished, but nevertheless Finney became involved in controversies, particularly as regards the "new measures" he was alleged to be using. The result was a conference held at New Lebanon, New York, at which his critics, mostly from New England, were pitted against the men on Finney's side, mainly from Oneida County, New York. This trial, at which the "new measures" rather than Finney himself were being questioned, resulted in his name being spread abroad, with consequent enhancement to his career.

The ensuing revivals were the greatest of his entire career, with the Rochester revival of 1830-31 being the high point. The unique feature of this Rochester campaign, and later ones in 1842 and 1856, was that his audiences consisted, in large part, of lawyers and other men in the professions.

The pressures of an evangelistic ministry becoming too heavy for a man with family responsibilities, Finney was induced to accept a pastorate in New York City. After several years of successful work at the Chatham Street Chapel, he resigned from the Presbyterian Church to become pastor of the famous Broadway Tabernacle (Congregational).

From New York City, Finney journeyed to Oberlin College, where he became the first Professor of Theology, and subsequently president from 1851 to 1866. His theology, which placed great emphasis on human responsibility in contrast with the prevailing Calvinism of the day, evolved from an emphasis on making men Christians to that of keeping them so. This latter attempt was called Oberlin Perfectionism, and Finney met with much opposition because of it.

Finney was the first, or one of the first American itinerants, to travel to foreign shores. He made two trips to England, in 1850 and 1860, experiencing success on each visit.

The evangelist led a full life, publishing many volumes of his lectures, numerous tracts, and a host of articles for the Oberlin Evangelist and other contemporary papers. He was prominent in major reform movements, but his influence in this respect comes mostly through the prominence of some of his converts as reform leaders.

Finney was not a mere sensationalist, for he constructed a theology which harmonized with his era, and he found a way of personalizing religion through the use of various measures. He linked evangelical religion to reform and helped establish Oberlin College as a going institution. He died in Oberlin in 1875.

Microfilm $5.70; Xerox $19.80. 445 pages.

AGRARIANISM IN ALABAMA 1865-1896

(L. C. Card No. Mic 59-6445)

William Warren Rogers, Ph.D.
The University of North Carolina, 1959

Supervisor: Fletcher M. Green

After the Civil War ended in 1865 Alabama farmers faced the difficulties of overcoming the destruction of war, the re-establishment of the productivity of their land, and adjusting themselves to an entirely new labor system. They were also faced with chronic economic depression. Out of this situation came the share cropping and crop lien systems characteristic of the New South. This study examines the period from 1865 to 1896 in Alabama and traces the impact of the major political, social, and economic forces on the state's agricultural classes.

Alabama agrarians attempted to better their economic condition by forming agricultural organizations, including the Grange, the Alabama State Agricultural Society, the Agricultural Wheel, and the Farmers' Alliance. Educational and social benefits were provided by county and state fairs, farmers' institutes, the Department of Agriculture, agricultural experiment farms, and the Agricultural and Mechanical College.

Finding that the agricultural organizations failed to alleviate their economic plight, the farmers turned to politics in the 1890's and organized the Populist Party. The result was a series of bitter political campaigns between the Populists and the entrenched Democrats. The farmers charged that they were being discriminated against on the national level by the Republican Party, and that the Eastern and dominant wing of the Democratic Party had little sympathy for their demands for easy money. Closer home, the farmers found that the conservative Bourbon Democrats were interested only in their own personal aggrandizement and pursuing a policy of retrenchment and reform. The Populists rallied behind the political leadership of Reuben F. Kolb, the state's most prominent agriculturist. By illegal manipulation of the Negro vote in the Black Belt the Democrats were able to defeat Kolb's attempts to win the governorship. The Populists, who often joined forces with the Republican Party, were more successful in the congressional and the state legislative elections.

In the 1896 national election the Democrats incorporated the free silver issue into their platform, and the Populists endorsed the Democratic Presidential candidate, William Jennings Bryan. As a result the Alabama Populists and Democrats became reunited. The Populists, who for a time had championed Negro voting rights, returned to the Democratic Party and accepted the creed of

white supremacy. Many of the political and economic demands of the farmers were later written into law. The agrarian movement in Alabama represented a dedicated attempt by the farmers to achieve for themselves a position of equality with other groups in society.

The chief sources for this study include both federal and state official documents, diaries, manuscript collections, newspapers, agricultural journals, and proceedings of various agricultural associations. Contemporary books, articles, and pamphlets, as well as more recent works have been utilized. Of particular value are the numerous newspapers that served as organs for the Populists. These journals provide an insight into the attitudes of the farmers and information concerning the leading personalities and policies of the agrarian movement.

Microfilm $7.35; Xerox $25.20. 580 pages.

HISTORY, ANCIENT

STUDIES IN SEA-POWER IN THE EASTERN MEDITERRANEAN IN THE CENTURY FOLLOWING THE DEATH OF ALEXANDER

(L. C. Card No. Mic 59-5201)

Irwin Loeb Merker, Ph.D.
Princeton University, 1958

This dissertation contains a study of the struggle for control of the Aegean basin and the eastern Mediterranean. Because of the limitations of ancient war-ships, it was necessary for a power which wanted to rule the sea to obtain bases for its ships. The islands of the Aegean and the coasts of Asia and Kypros offered a perfect string of bases with which to dominate the seas between Greece and Egypt, and the power which controlled these bases usually controlled the sea and vice versa.

In the first chapter there is a brief survey of the naval situation on the death of Alexander the Great in 323. A treatment of the naval actions of the Lamian War, along with the collapse of the Athenian navy which left the field clear for the Diadochoi follows. At the end of the chapter is an investigation of the literary and epigraphical evidence for the founding of the League of the Islanders, the instrument of control of the Aegean Islands founded by Antigonos I and revived and used by the Lagids. The founding of the League is here dated in the late summer of 314.

The second chapter continues narrating the story of the control of the Aegean and eastern Mediterranean. It traces the Antigonid hegemony to its height after Salamis and its decline after Ipsos. Special attention is paid to the expedition of Ptolemy Soter to the Isthmos in 308. The end of the chapter is concerned with Demetrios Poliorcetes' loss of Athens and his final expedition to Asia in 286. In the third chapter the League of the Islanders, the instrument for the Lagid control of the Aegean is investigated. It starts with a treatment of the Egyptian officials who are connected with the League, their backgrounds, duties, etc. This is followed by a discussion of the extent of the League.

The fourth chapter deals with the Macedonian victories of Kos and Andros. Kos is dated in the course of the Chremonidean or the Second Syrian War, and Andros is dated in 227. The chapter ends with a survey of the control of the Aegean from 286 to 227 and the factors contributing to this control. The fifth chapter is a survey of all the evidence adduced by scholars to prove the reality of the Karian expedition of Antigonos Doson. The reality of this expedition, which is to be dated in 227, has recently been demonstrated by newly discovered inscriptions from Labranda. In the sixth chapter there is a treatment of the silver coinages of Antigonos Gonatas and Antigonos Doson. On the basis of the hoard evidence, the Pan-head tetradrachm is assigned to Antigonos Gonatas, while the Poseidon-head coin is attributed to Antigonos Doson. This last attribution together with the dating of the Karian expedition in 227 help to date the battle of Andros mentioned above in the reign of Antigonos Doson. The one drachm piece is connected with the Pan-head coin. The Pan-heads with the kalathos and the Athena facing right on the reverse are assigned to Athens under Macedonian control after the Chremonidean War. Those with the Macedonian helmet and Athena facing left are shown to be earlier than the kalathos coins. Finally there is an appendix which treats of the value to be assigned to the evidence drawn from the Delian foundations which were established by important third century personages.

Microfilm $2.50; Xerox $7.80. 170 pages.

HISTORY, MEDIEVAL

ASSEMBLIES AND EARLY REPRESENTATION IN WESTERN LANGUEDOC, 1175-1275.

(L. C. Card No. Mic 59-5157)

Thomas Noel Bisson, Ph.D.
Princeton University, 1958

This is a study of the composition and function of assemblies in western and upper Languedoc during the period of transition from seigneurial autonomy to royal overlordship. Originally the lord's court of vassals and followers was the most characteristic type of regional assembly. This was a ceremonial, publicistic, and consultative body. The court of the county of Toulouse tended to be localized in composition, most often made up of knights of the Toulousain and adjacent districts. The countryside nobility of lower Languedoc regularly attended the vicecomital assemblies of Béziers and Narbonne. Town knights and notables were prominent in feudal gatherings everywhere in Languedoc.

With the emergence of the consular community and urban institutions in this period, the town parliament became an institutionalized assembly. Composed theoretically of all free men of the town, lords and consuls used it to explain policies, to rally townsmen to their support, or to gain approval of legislation, particularly in financial matters.

A third kind of assembly corresponded to the diocesan communities of upper Languedoc. Late in the twelfth

century, conventions of clergy, barons, and regional notables instituted cooperative peace movements and taxation in Rouerque and the Albigeois. Similar development followed later in Quercy, where the diocesan assembly seems to have maintained some control of the peace taxation.

The one regular district assembly was that of the Agenais, on the lower Garonne. It was summoned by the overlord or his seneschal, and was composed of knights and town delegates. These elements composed a diocesan community which was very jealous of its privileges. At certain moments it had sufficient authority in assembly to control or influence policy. Unlike most other regional assemblies of Languedoc, the "court of the Agenais" was a high judicial tribunal as well as a consultative body.

Both in Quercy and the Agenais, community rights in relation to the diocesan coinages were so defined as to oblige the bishops to negotiate for mutations with the district assemblies. Certain urban communities were likewise able to limit seigneurial monetary rights through parliaments. In many towns lords or consuls had to deal with patrician-dominated councils to levy local impositions, and in a few places they were required to summon the general assembly. The incidence of taxation was discussed in parliaments of large towns like Narbonne and Albi. In some cases extraordinary grants, such as the crusading fouages, were made by parliaments. But there is little evidence that communities of Languedoc claimed rights of assembly or consent, and the constitutional significance of town and diocesan meetings must not be overestimated.

The period of the Albigensian crusade (1209-1229) was marked by a few notable general assemblies, composed chiefly of prelates and barons. Under the increasingly bureaucratic administration of Louis IX and his brother Alfonse, who inherited the county of Toulouse in 1249, there was greater reliance on central assemblies for purposes of negotiation and consultation. The first town representation on a large scale occurred in the fealty proceedings of 1249, although it was known in the Agenais even in the twelfth century.

Men of the three estates assembled in the royal districts several times after 1254 to consider whether to prohibit grain export. While there was no representation of orders, these gatherings provide early evidence of Romano-canonical procuration. A survey of its origins in Languedoc indicates that the procedural importance of this representation was understood, but it was utilized voluntarily as a form of excuse, not as an administrative device, in the export meetings. Government officials summoned regional and local assemblies primarily for reasons of consultation and publicity.

Microfilm $5.25; Xerox $18.60. 412 pages.

THE CANONS OF PRÉMONTRÉ AND THE MEDIAEVAL UNIVERSITIES OF NORTHEAST GERMANY

(L. C. Card No. Mic 59-6572)

James Joseph John, D.S.M.
University of Notre Dame, 1959

This work is a preliminary contribution to the history of the intellectual life of the canons of Prémontré in Northeast Germany. The Premonstratensian Order, founded by St. Norbert in 1120 at Prémontré in Northern France, quickly spread to Germany and played a leading role in Christianizing the lands east of the Elbe in the twelfth and thirteenth centuries. The Order maintained itself in this region with varying success till the triumph of the Protestant reform.

An attempt has been made here, through an examination of matriculation and promotion records, to trace all the members of the Order who had studied at Northeast German universities during the mediaeval period. The first part of the work treats these canons in relation to the universities of Prague (founded in 1348), Erfurt (1392), Leipzig (1409), Rostock (1419), and Greifswald (1456). The four faculties into which the mediaeval university was traditionally divided provide the framework for the discussion. The second part consists of biographically annotated lists of Premonstratensian students at the five universities just mentioned plus Wittenberg (founded in 1502) and Frankfort on Oder (1506). The writings left by at least seven students and the manuscripts containing them are catalogued in this section.

Of 135 authenticated members of the Order found at these universities, where they account for 155 matriculations, Leipzig had attracted 44, Erfurt 29, Rostock 27, Prague 26, Wittenberg 17, Greifswald 10, and Frankfort 2. At least 27 monasteries are represented from 10 different provinces of the Order. The large and favorably situated Saxon province provides over three-fifths of the students. The much smaller Ilfeldian and Slavic provinces, also well situated, account for 14 and 8 respectively. The remaining students are thinly scattered in outlying provinces. Of individual monasteries, the cathedral chapters of Brandenburg, Havelberg, and Ratzeburg account for 35, 21, and 6 students respectively. Other monasteries with more than token representation are Ilfeld (11), Belbuck (7), Gottesgnaden (6), Leitzkau (5), and Speinshart (5).

The students' interests seem to have been directed almost exclusively towards the faculties of arts and canon law, to the neglect of theology, surprisingly enough, and medicine. At least 22 students were promoted in arts and 40, of whom 17 received degrees, are still traceable in law faculties. One master had been dean of the Erfurt arts faculty before joining the Order. One doctor of canon law served as a professor at Leipzig and may even have been dean there. The lone medical student traceable became professor of medicine at Rostock and Greifswald. There is some evidence that the students preferred realism to nominalism in philosophy. At least six canons functioned as conservators of university rights and privileges. One tried valiantly to reform academic standards at Leipzig. Another led a bloody fight to re-establish a sound financial basis for the University of Rostock. A group of them made a major contribution to the foundation of the University of Greifswald. As bishops, abbots,

provosts, priors, etc., after they returned to their monasteries, the students were in a strong position to influence the affairs of the Order.

Although the Order in this region did not develop any common policy towards university education, a fact speaking for a decline in its cohesiveness in the late Middle Ages, the deep-rooted educational traditions maintained by a number of individual monasteries and the prominent part taken by not a few canons in the academic life of the time clearly show that nothing intrinsic to the Premonstratensian way of life prevented the Order from assuming more importance in the intellectual life of Northeast Germany. Microfilm $5.45; Xerox $19.20. 427 pages.

HISTORY, MODERN

THE DEVELOPMENT OF PROCEDURE IN THE HOUSE OF COMMONS IN THE EARLY STUART PERIOD (1603-1629)

(L. C. Card No. Mic 59-5066)

Gertrude Joanne Amspoker, Ph.D.
University of Minnesota, 1959

The position of Parliament in its conflict with the early Stuarts was notably strengthened by the development of increasingly effective procedures in the House of Commons. The aim of this thesis is to show what advances in procedure were made between 1603 and 1629 and how these advances, as they expanded the Commons' capacity to dispatch business effectively, also furthered the protection of the liberty of Parliament and of the subject. Sources used include the Commons' Journals, published and unpublished parliamentary diaries, and various other contemporary commentaries.

James I and Charles I faced an opposition in the Commons which reflected the convictions of the Puritan gentry and merchants as these classes assumed new wealth and power in English society. This opposition, among whom were many common lawyers, was keenly aware of the close relationship between procedure and substance. Substantive gains came through procedures which were more exactly defined, strengthened, and more firmly enforced than ever before.

The growth of procedure was a continuous process. Modifications often followed patterns outlined by Tudor Parliaments; in other important respects, new forms evolved. The Commons' assertions, substantive and procedural, sometimes lacked historical warrant and could not be vindicated at once. But by the twenties, forceful procedures gave the opposition weapons with which to express a resolution and a determination never before evident. Many of these procedures contributed significantly to the achievements of the Long Parliament and to the ultimate victory of Parliament in the constitutional struggle.

The vindication, in 1604, of the Commons' jurisdiction over election returns required the development of procedures to determine election disputes and to establish qualifications for membership in the House. One decisive action excluded the Attorney-General from membership.

In many ways, the Speaker's effectiveness as a royal protagonist in the Commons was curtailed. He lost his traditional power to direct the order of business. His participation and responsibility in debate were carefully defined. The Commons developed procedures to determine the form of questions upon which they were to vote and to specify when votes were to be taken. Decisions were frequently reached by divisions, which checked the Speaker's judgment as to the outcome of oral votes. Flexibility and circumvention of the Speaker's influence were attained through the expanded role of committees and the development of the committee of the whole House and of a system of standing committees. The Commons denied the Speaker's right to decide when a day's business would begin and end; they often claimed the right to declare a recess when they chose. On the final day of the 1629 session, they failed to sustain their protest against the Crown's power to adjourn them without their consent.

The strongest possible procedures were persistently used to advance the Commons' privilege of free speech in its dual facets: the right to debate whatsoever matters concerned the governance and welfare of the commonwealth and the right of members to speak freely in debate, subject only to the discipline of the House. High standards of debate were maintained. Procedure on bills received more exact definition than previously; the opposition assumed the initiative in the introduction of bills and in efforts to give continuity to the legislative process. A committee was set up to supervise the Clerk's Book. Firmer control of procedure in conferences and in other contacts with the Lords afforded the Commons new assurance in relationships with the upper House.

All of these developments gave the Commons a position of new strength against the Crown; this was the heart of the matter. Microfilm $4.30; Xerox $14.40. 334 pages.

JOHN ADAMS, PURITAN REVOLUTIONIST: A STUDY OF HIS PART IN MAKING THE AMERICAN REVOLUTION, 1764-1776.

(L. C. Card No. Mic 59-2839)

Warren Hasty Carroll, Ph.D.
Columbia University, 1959

This study has a twofold purpose: (1) to elucidate the reasons for John Adams' consistent support of the cause of the American Revolution from 1764 to 1776; and (2) to describe his affiliations with that cause and his contributions to it. The hypothesis is advanced that John Adams was primarily motivated in his support of the American Revolutionary movement by his admiration of the Puritan revolutionaries of the previous century and their concept of a special mission and destiny for America. As proof of this hypothesis evidence is presented indicating the persistence of the Puritan political tradition in eighteenth-century New England and Puritan influences in John Adams' own writings are traced. The persistence of the Puritan tradition in New England in the time of the American Revolution is demonstrated by: (1) Jonathan Mayhew's sermon on passive obedience and non-resistance in 1750; (2) references to the example of the Puritan revolutionaries in writings between 1765 and 1776; (3) the legend of Joyce Junior; (4) indications of the significance of

Oliver Cromwell as a revolutionary symbol. Puritan influences on John Adams are explored under the following five headings: (1) influence of the seventeenth-century Puritan revolutionaries of England and Calvinist revolutionaries of Europe on John Adams as a revolutionist; (2) influence of the example of the Puritan founders of New England on John Adams' ambitions and loyalties; (3) influence of the Puritan heritage on John Adams' view of American national destiny; (4) John Adams and Calvinist orthodoxy; and (5) Puritan influences on John Adams' political theory. Under the first three of these headings the direct contributions of the Puritan heritage to John Adams' revolutionary career are delineated, while on the subjects of Calvinist orthodoxy and political theory apparent divergences of John Adams from classical Puritanism are analyzed in the light of the hypothesis here advanced.

The remainder of the study traces John Adams' participation in the events leading up to the Declaration of Independence in eight stages: (1) the emergence of his patriotism during the Stamp Act crisis; (2) his work with the Boston Sons of Liberty from 1766 to the Boston Massacre; (3) his defense of Captain Preston and the soldiers in the trials resulting from the "Massacre" and its consequences for Adams; (4) his selection as a delegate to the First Continental Congress at Philadelphia and his work there in 1774; (5) an analysis of the content of the Novanglus Papers; (6) John Adams' part in urging more radical military and political measures after the outbreak of war; (7) his work in promoting the war effort and in urging the assumption of self-government in autumn 1775 and winter 1776; (8) his part in the decision to make a formal declaration of independence. The study concludes with a brief summary of John Adams' character and place in history and an extensive bibliography together with a chronological list of primary sources.

Microfilm $5.85; Xerox $20.40. 457 pages.

A REVOLUTIONARY CONSERVATIVE: THE PUBLIC LIFE OF WILLIAM CUSHING, 1732 - 1810.

(L. C. Card No. Mic 59-6187)

John D. Cushing, Ph.D.
Clark University, 1959

Supervisor: Gerald N. Grob

William Cushing of Scituate, Massachusetts, was born in 1732, the thirteenth child of the third generation of leading Massachusetts jurists. Upon graduation from Harvard in 1753, he too embraced the legal profession and was admitted to the bar in 1755.

Most of his career as an attorney was spent in the District of Maine where he built a flourishing practice. While he represented every possible type of client he was constantly associated with the large land companies and their proprietors who fought for possession of the valuable timber of the region.

In 1772 Cushing was appointed to the Superior Court of Judicature to succeed his father. As a jurist he was held in esteem by all parties, but within a year he was forced to choose between loyalty to the crown and joining the radical Whigs who used the court as a focal point in the debates over taxation. He made the choice with the greatest of reluctance, and was the last member of the court to do so, but circumstances have since won for him the reputation as a staunch patriot.

When the Provincial judiciary was reorganized in 1775, Cushing was appointed to the bench and, in the absence of Chief Justice John Adams, presided for over a year until he was formally appointed Chief Justice.

From the opening of the new tribunal, Judge Cushing used his high office to strengthen the Revolution by securing obedience to law and support for the Revolutionary government. The first was accomplished by rigidly adhering to the administration of justice as it had been known for generations; while the second was achieved by using every opportunity to make pertinent charges to the grand jury in each county.

With statute law in an uncertain state, Cushing became noted for his use of common law and natural law to serve the needs of his time. In his speeches from the bench and in his charges to the jury, his pronouncements were conspicuous for their conservative approach and for their legalistic thinking. In both cases, he attempted to reason support for the revolutionary cause, and to confine the Revolution to the narrowest limits consistent with independence. At every turn his speeches emphasized the necessity to preserve two great objectives of the day, liberty and property. Cushing was particularly sympathetic to the latter, and it is clear that he tended to favor the conservative property owning classes of eastern Massachusetts. This is well reflected in his speeches in support of both state and national constitutions, and during Shays' Rebellion when all constitutional order, liberty, and property were in danger.

In addition to his strictly judicial duties, Cushing was also called upon to perform other services of importance, such as helping to revise the legal code of the Commonwealth, serving on ad hoc committees, fixing the value of the state securities and currency, rendering advisory opinions to the executive and legislative branches of government, and serving as a delegate to state conventions on both national and state constitutions.

With the adoption of the Federal Constitution, Washington appointed him to be first associate justice of the Supreme Court and, in 1796, appointed him Chief Justice. This position was declined on grounds of ill health, but Cushing spent the remainder of his life on the federal bench, serving the Federalist cause faithfully, if without distinction. Microfilm $4.55; Xerox $15.40. 356 pages.

SPEARHEADS FOR REFORM--THE SOCIAL SETTLEMENTS AND THE PROGRESSIVE MOVEMENT, 1890-1914.

(L. C. Card No. Mic 59-5758)

Allen Freeman Davis, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Merle Curti

Settlement workers played important roles in the movements to promote social justice and improve urban

conditions in the Progressive era. A career-line study of a selected group of settlement workers shows that the typical settlement worker in the years from 1890 to 1914 was a young, well-educated man or woman who came from an old-stock American family, inherited a tradition of service from his parents, and acquired a sense of responsibility from his Congregational-Presbyterian background. The most important impulse behind the growth and development of the settlement movement in America was a broadly religious humanitarian urge to help solve the problems of urban, industrial America. The settlement idea was imported to America from England, but the settlement movement had many precedents in America and its development was largely the product of American need and experience. The settlement idea, as interpreted by the leading American settlement workers, led naturally to participation in urban reform movements.

Only a minority of the settlement workers became active reformers, but this minority had an importance far beyond its numbers. Especially in Boston, Chicago, and New York, settlement workers became initiators and organizers of reform. In Chicago, attempts to improve conditions in the neighborhood caused Jane Addams and the other Hull House residents to oppose Johnny Powers, the local political boss. The Hull House reform movement failed; but at Chicago Commons Graham Taylor, Raymond Robins, and other settlement workers built up a political organization that effectively controlled the elections in the ward for many years. The settlement workers' observations and investigation of the actual conditions in the working-class neighborhoods of the city enabled them to play important roles in the movements for municipal reform, especially in Boston, Chicago, and New York. In Chicago settlement workers cooperated with the Municipal Voters' League and played a part in the unsuccessful campaigns for municipal ownership of street railways. In New York James B. Reynolds and other settlement workers played prominent roles in the reform campaigns of 1897 and 1901. In Boston settlement workers were active participants in the 1909-10 reform campaign.

Settlement workers usually supported the cause of organized labor, and the Chicago Stock Yards Strike of 1904 illustrates the settlement workers' role during an industrial crisis. Settlement workers played a significant part in the movements to aid the working women and children. In many states they helped win better legislation and they aided in the organization of the National Child Labor Committee and the Federal Children's Bureau. They helped to organize the National Women's Trade Union League, and they initiated a federal investigation of women and children in industry.

Participation in reform movements in the neighborhood and the city led the settlement workers to participation in reform at the national level. They played an important part in the campaign that led to the appointment of an Industrial Relations Commission and they were active participants in the Progressive campaign of 1912. For many settlement workers the Progressive Party seemed like the climax to their long struggle to promote social and industrial justice. The collapse of the Progressive Party in 1914 and the outbreak of World War I, among other things, led to a basic change in the settlement movement. After World War I the settlements were no longer spearheads for reform in the city.

Microfilm $5.25; Xerox $18.40. 410 pages.

CONTRIBUTIONS OF U. S. ARMY AVIATION TO USES AND OPERATION OF AIRCRAFT

(L. C. Card No. Mic 59-5762)

Eldon Wilson Downs, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Chester V. Easum

In the postwar days after 1918 the United States Government had a great surplus of De Havilland (DH-4) airplanes and Liberty engines. In addition the war produced many experienced pilots who recognized that the airplane must have numerous peacetime uses. But apart from the government air services very little organized air activity existed and the Army Air Service found itself in the unique position of pioneering in the development of commercial aviation and peacetime uses of the airplane. These contributions are the subject of this study.

Within the Air Service and later the Air Corps were many individuals who demonstrated successfully the numerous advantages of the airplane. Among those Army officers who pioneered the new uses of aircraft were well-known military aviators like Henry "Hap" Arnold. Less well known, perhaps, were pilots with engineering or technical training who concentrated their efforts on specialized activities. These included test pilot John Macready who flew the first plane to scatter poison dust on treetops, and Albert W. Stevens, who demonstrated the uses of aerial photography. Numbered among the aviators were also Donald Bruner who experimented with night flying, Edward Hoffman an inventor of a parachute, and Albert Hegenberger who studied and experimented with blind flying procedures, and many others. All helped to prepare the way for the commercial aviation firms to win acceptance by the general public. The Army was not alone in doing this; the Navy, the Post Office Department and other governmental organizations also made substantial contributions.

The entrance into this pioneer work varied. Sometimes military air enthusiasts, humanly interested in their own welfare, became volunteers for some flying experiment, hoping to attract more public interest in a larger service force. Often another governmental agency unloaded a problem at Army's door as in the case of several agricultural experiments. Army aviators successfully completed the experiments, helping to determine for the department in question whether the airplane could perform the task more economically as well as more speedily than the ground vehicle. In aerial crop dusting the Army encouraged commercial aviation to enter the work rather than accept it as part of the mission of the military aviator.

In some instances, the continual development of the airplane and related equipment for the military art coincided with commercial development along similar lines. These were in such areas as the development of parachutes, night flying, airways, communications and navigational aids. Not always did the commercial interests welcome military development of an art. Even in the mid-twenties the military successes with aerial photography and mapping tasks conflicted with commercial interests. Certain commercial firms considered the Army aerial photographers as competitors and urged military withdrawal from aerial surveying and map-making.

The Air Corps tried to limit these activities, but other federal agencies forced the Army to continue some aerial mapping.

Naturally the Army aviators responded when an aerial experiment was an emergency. In this way the flyers participated in the aerial patrol of timberlands in the West. Much later under presidential decree in 1934, Air Corps flyers temporarily replaced commercial aviation companies on the airmail routes. The nation derived benefits from the airmail experience of the airmen. The greatest benefit was the awakening of the American people to the inadequacies of military aviation.

While not every contribution of army aviation undergoes review in this study, enough of the most significant are examined to reveal the attitudes, problems, failure and successes of military aviators in furthering commercial aviation while carrying out their own missions. The military flyers never wanted permanent civilian type missions for themselves. Commercial aviation was essential, they said, as a reserve for war.

Microfilm $6.40; Xerox $22.20. 502 pages.

RUSSIA'S BALKAN POLICY 1894-1905

(L. C. Card No. Mic 59-6188)

Thomas Glenn Duffy, Ph.D.
Clark University, 1959

Supervisor: Dwight E. Lee

Since Catherine the Great (1762-1796) Russia had pursued an active Balkan policy, which at different times, aimed at the destruction or control of the Turkish Empire. From 1894 to 1905 the tsar's government, while advancing in the Far East, desired, at the highest level, to preserve the existing Balkan territorial and political status quo.

The responsibility for Russia's foreign and domestic policy lay primarily with the sovereign. This had been true of Nicholas' predecessors and was true from 1894 to 1905 as well. The tsar's policy decisions were frequently influenced, however, by individuals close to him. These included his wife, mother, uncles and other persons in his favor, who were able to influence him. Among the more influential of his advisors were such important and representative figures as the Procurator of the Holy Synod, Pobedonostsev, the publisher of the influential newspaper Grazhdanin, and friend of Alexander III, Prince Meshchersky, the Minister of the Interior, Plehve, and the irresponsible advocates of a quick war with Japan, Bezobrazov, Andreyev and Admiral Abaza. Hence the tsar's policy decisions were not always his alone but frequently reflected the ideas of those relatives, friends or other persons who might be able to influence him.

In the Balkans the tsar's policy, on the official level at least, was consistent. It aimed at cooperation with Austria-Hungary to maintain the territorial and political status quo in southeastern Europe, and was so implemented in Serbia, Bulgaria and Macedonia. The Russian foreign ministers, Prince Lobanov-Rostovsky, Count Muraviev and Count Lamsdorff worked closely with Count Goluchowski, the Austro-Hungarian foreign minister, to maintain order in Serbia during the tense period of the return of King Milan and the near chaos resulting from the change from the Obrenovic to the Karajorjevic dynasties. Also, beginning with the reestablishment of normal relations with Bulgaria, the foreign ministers and the tsar strove to restrain Prince Ferdinand and the more bellicose elements of the Bulgarian government and society from fomenting war with Turkey.

Russian Turkish policy also reflected the desire of St. Petersburg to maintain the status quo in the Balkans. This desire was expressed in Russia's assumption, together with Austria-Hungary, of the mandate to implement reforms in the Turkish administration in the Macedonian vilayets. In the carrying out of the reform program the tsar's government proved the seriousness of its professed desire to maintain the Balkan status quo.

This policy of cooperation with Austria-Hungary, although operative at the field level in Macedonia during the Muerzsteg reform period, was, however, frequently inconsistent with the activities and behavior of Russian diplomatic representatives in Serbia and Bulgaria. In Belgrade two of the tsar's envoys, Jadovsky and Mansurov, apparently made their own policy. During the tenure of Bakhmetiev a similar situation prevailed in Sofia. There the Russian envoy, by his sympathetic encouragement of the Macedonian Internal Revolutionary Organization (IMRO), worked actively to bring about hostilities between Bulgaria and Turkey, hoping thereby to force his sovereign to intervene on behalf of Bulgaria. Bakhmatiev, it seems, also spared no effort in his attempts to increase Russian prestige and influence in Bulgaria.

In spite of such activities the Russian foreign office, whether unwilling or unable to remove its representatives in Sofia and Belgrade, nevertheless, during this period, was able to maintain peace and the status quo in the Balkans. This was made possible primarily by the spirit of mutual trust and cooperation which was built up and maintained relatively consistently between the Russian and Austro-Hungarian envoys at Constantinople and the foreign ministers at St. Petersburg and Vienna.

Microfilm $3.35; Xerox $11.40. 257 pages.

THE SOCIAL CONSCIENCE OF SOUTHERN BAPTISTS FROM 1900 TO THE PRESENT AS REFLECTED IN THEIR ORGANIZED LIFE

(L. C. Card No. Mic 59-5636)

John Lee Eighmy, Ph.D.
University of Missouri, 1959

Supervisor: Lewis E. Atherton

The attitude of Southern Baptists toward social issues and the church's role in society has been shaped largely by their conservative theology and environmental background. As the largest religious group in the South, they have reflected the region's ruralness, intellectual isolation, and economic backwardness. The autonomy of democratically governed churches devoted to the revivalistic tradition of personal evangelism has hampered responsible social action by centralized agencies.

Doctrinal and environmental factors explain why Southern Baptists took no part in the social gospel movement in

American Protestantism in the late nineteenth century which applied Christian principles to social conditions created by the rise of an industrial society. Southern Baptists feared the movement also because of its alliance with liberal theology which de-emphasized the personal and supernatural aspects of religion.

After 1900 social Christianity began to make fruitful contacts with Southern Baptists. The theological seminaries began offering courses in sociology. The Southern Baptist Convention and, eventually, all the state conventions set up social service committees to deal with social issues. Southern Baptists generally endorsed the idea that the mission of Christianity included the whole of society.

While approving certain aspects of social Christianity, Southern Baptists did not forsake their conservative tradition which emphasized personal evangelism. None of the social service committees became socially effective. Their work mainly consisted of annual reports which treated social problems superficially, often describing them as the outgrowth of individual failures. The committees concentrated on matters of personal morality, particularly prohibition, and were willing to advocate political action on such questions.

The social gospel ideology, nevertheless, made some progress against the exclusive domain of personal evangelism. The more liberal element tried to set up a strong social action agency in the Southern Convention during the mid-thirties. The plan failed under the charges that it fostered a centralized program of social betterment which violated local church autonomy and conflicted with personal evangelism.

Since World War II important gains have been made in the Southern Convention in developing responsible attitudes toward social issues. Beginning in the late thirties, Southern Baptists became alarmed over the loss of religious freedom in totalitarian states and the domestic practice of offering government welfare services to religious institutions, which they believed violated the principle of church-state separation. This issue helped convince Southern Baptists of the need for centralized agencies to voice their views in society. As a result they created an agency devoted to preserving church-state separation which employed a director in 1946.

Of greater importance in this study was the expansion of the Social Service Commission to a full-time agency in 1947, after operating more than thirty years without employed leadership. The work of the Commission (renamed the Christian Life Commission in 1952) has improved and expanded steadily, although it still functions on a limited scale. Its policies reflect the Convention's decentralized structure and conservative traditions. It concentrates on a program of education which relates general Christian principles to social issues, rather than advocating direct political action in support of specific proposals.

At mid-century Southern Baptists still are not equipped adequately in disposition and denominational program to meet their social obligations and opportunities. Since 1900 progress has been made, however, in terms of organization and leadership. The teachings of social Christianity have permanently affected the denomination's life and thought, which offers hope for continued improvements in the social conscience of Southern Baptists.

Microfilm $3.55; Xerox $12.20. 276 pages.

THE REGULATION OF CHILD LABOR IN NEW YORK STATE, 1886-1942, WITH EMPHASIS UPON THE WORK OF THE NEW YORK CHILD LABOR COMMITTEE.

(L. C. Card No. Mic 59-6302)

Jeremy Pollard Felt, Ph.D.
Syracuse University, 1959

Supervisor: O. T. Barck

Although the problem of child labor in the United States was subject to federal control for brief periods between 1916 and 1922, the main task of regulation was left entirely to the individual states. Of particular interest and significance was the campaign to end child labor in the populous, industrial state of New York, which entered the twentieth century with a formidable child labor problem and emerged forty years later with one of the highest legislative standards in the United States. That it did so was almost entirely due to the efforts of the New York Child Labor Committee (1902-1942), upon whose papers this study is primarily based. The Committee's files, hitherto unexamined, lent new dimensions to the history of reform within New York State.

When the New York Child Labor Committee began its work in 1902, New York's child labor legislation was extremely defective and largely unenforced. Working steadily to overcome public inertia, the Committee developed into a highly effective pressure group, equally at home in the drafting of proposed legislation, in the management of child labor investigations, or in the preparation of publicity. Although the Committee was strictly a private organization composed, in the main, of conservative progressives, it actually acquired a semi-official status and worked closely with the governors and with the State Departments of Labor, Education, and Health. Among the prominent members were Florence Kelley, Lillian Wald, Jacob Riis, Waddill Catchings, George Alger, and George Hall.

In 1903 the Committee obtained major legislation affecting children in factories, in mercantile establishments, and in the street trades. Formidable enforcement problems, however, continued to exist, and the Committee's main emphasis was placed upon securing adequate enforcement while continuing its work for higher legislative standards. The Committee members were basically uninterested in achieving federal regulation, and when they became involved in the struggle to ratify the Child Labor Amendment to the United States Constitution (1924-1938) their state effort was weakened to such an extent that they drastically reduced their participation in the ratification campaign.

The Committee's attempts to end child labor in tenement home work, in the street trades, and in agriculture, were considerably less successful than its efforts to abolish it in industrial and commercial establishments. It would have been as unthinkable, however, for the conservative Committee to have advocated the sudden promulgation of a blanket child labor code as it would have been impossible for them to have obtained its passage. New York's child labor legislation often resembled a patchwork of conflicting and ambiguous statutes, and public resistance to the regulation of trades such as that of the newsboy

was formidable. Nevertheless, the slow build-up of New York's legislation was illustrative of the necessary and beneficial gropings of a democracy. By appreciating the difference between legislation and enforcement the Committee members avoided a common pitfall of reform organizations and achieved child labor reform to the largest extent possible for the times in which they lived.

Microfilm $4.05; Xerox $13.60. 315 pages.

THE ECONOMIC BOOM OF THE 'TWENTIES IN LOS ANGELES

(L. C. Card No. Mic 59-4416)

James Clifford Findley, Ph.D.
The Claremont Graduate School, 1958

The decade of the Nineteen Twenties was very important in determining the growth of Los Angeles. The population of the city more than doubled, and the foundations for a future industrial center were established. Economic booms were experienced in petroleum, real estate, and motion pictures, and the initial development of the aircraft and automobile assembly industries was recorded. The growth of banking and finance was significant, but speculation was rife, particularly in oil stocks. A number of fraudulent promotional activities were uncovered, the most serious of which was the stock overissue which ended in the collapse of the Julian Petroleum Company in 1927.

Advertising continued to play an important part in the economic development of Los Angeles. The city had long been a center of the winter tourist trade, and with the founding of the All-Year Club of Southern California in 1921, community leaders began to stress the excellence of the summer climate as well. In addition business leaders and organizations, particularly the Los Angeles Chamber of Commerce, recognized the necessity for providing employment for the thousands of new residents, and therefore undertook to establish what was termed "balanced prosperity." Los Angeles industrial development, therefore, was at least partially the result of promotion, and the growth of manufacturing during the decade, particularly in the form of branch plants of Eastern concerns, was rapid.

Aside from the economic advance there were a number of factors which were influential in determining the pattern of future metropolitan growth. The increasing use of the automobile enabled the population and the business life of the community to spread out over a very large area. At the same time there was a failure to improve very much the existing public transportation facilities, and the result was the initial economic decentralization of business with a consequent decline in the importance of the central business district of Los Angeles. By the end of the decade, both urban and economic decentralization were evident, and the Los Angeles area had become a great sprawling metropolis, with satellite business centers beginning to rival the central business district in importance.

In short the decade of the Nineteen Twenties was the period when the City of Los Angeles first emerged as a major urban center which was rapidly on the way to becoming the third largest city in the United States.

Microfilm $5.90; Xerox $20.60. 462 pages.

THE OPPOSITION OF THE NOTABLES DURING THE SECOND EMPIRE, 1859-1864.

(L. C. Card No. Mic 59-6600)

Walter Dennis Gray, Ph.D.
University of Notre Dame, 1959

This dissertation examines the opposition of the Notables during the Second Empire from 1859 to 1864 or from the Italian War to the September Convention. The term, "Notables," although more the creation of the twentieth-century historian, refers specifically to the political opposition which stemmed from: the Legitimists who desired a Bourbon restoration; the Orleanists who desired an Orleanist restoration; a group of liberal Catholics; and a group of Liberals, chiefly academicians and journalists, who were essentially indifferent to the ruling dynasty provided it safeguarded parliamentary institutions and liberty. In short, the Notables were liberals in the nineteenth-century meaning of the term. At times the business community and many Catholic prelates, clergy, and laymen allied themselves with the Notables to oppose the Second Empire.

The years 1859-1864 mark a definite turning point in the history of the Second Empire. The Italian War, the Cobden Treaty, the Roman Question, the political concessions of 1860-1861, the imperial foreign policy, and the elections of 1863 crystallized the opposition of the Notables and permitted them to ally themselves with the Clericals and the business community in opposing the Second Empire. Indeed, they exploited every embarrassment of the imperial government. They comforted the Clericals in agitation over the loss of the papal territories and also the discontent of the business community over the Cobden Treaty. They opposed the imperial foreign policy and they were sceptical of the political concessions of 1860. They consistently advocated a return to parliamentary government, increased freedom of the press, and an end to caesarism as the only means of solving France's domestic and foreign problems. Their opposition, however, was genteel and usually consisted of academicians' speeches, articles in periodicals, meetings in fashionable salons and country estates, and only an occasional public demonstration. Their aristocratic temperaments were no match for universal suffrage and the rigid press censorship laws of the Second Empire. Their active participation in the electoral campaign of 1863 was only moderately successful as Napoleon III had skillfully removed several of the issues by his political concessions.

After 1859 the Notables benefited from the political concessions of Napoleon III and in part they were aimed at winning them over to the Empire. During the years, 1859-1864, a French parliamentary life began to evolve and the Notables could express themselves cautiously in speeches, articles, and books. The laws of the Empire, in part due to the political principles of Napoleon III and in part due to the agitation of the Notables, were gradually modified after 1860 so that the later Liberal Empire was foreshadowed by the political concessions of 1860-1861. Napoleon III succeeded in channelling the opposition of the Notables in such a way that after the elections of 1863 it either became ineffectual or virtually became a loyal opposition. With the signing of the September Convention the decisive years of the Notables' opposition to the Second Empire had ended.

The chief sources of information were the procurator reports for the years 1859 to 1864, the unpublished papers of Thiers and other Notables, the opposition press, and the published memoirs and political tracts of the Notables.

Microfilm $4.35; Xerox $14.60. 339 pages.

AMERICAN EUGENICS: HEREDITY AND SOCIAL THOUGHT, 1870-1930.

(L. C. Card No. Mic 59-5775)

Mark Hughlin Haller, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Merle Curti

The eugenics movement rose out of the ferment of ideas resulting from Charles Darwin's theory of evolution. Its basic doctrine was simple: that heredity plays a dominant role in the life of man and that man's hereditary endowment can be improved through encouraging propagation by those with desirable genes and restraining propagation by those with undesirable genes. The movement had its origin in England at the turn of the century under the guidance of Francis Galton, the great English scientist and founder of eugenics.

In the United States during the nineteenth century, the way was prepared for eugenics by a growing emphasis upon heredity among students of the dependent and delinquent classes and by the expanding racist opposition to immigration. In the twentieth century such currents coalesced with new developments. The rediscovery of Mendelian genetics stimulated research in heredity and enhanced the confidence of many scientists in their ability to predict and control inherited traits. The introduction of Binet tests not only gave psychologists a new tool for diagnosing feeblemindedness but also, for a time, seemed to provide a means for measuring and studying innate intelligence. With the founding of the Eugenics Record Office in 1910 under the biologist, Charles B. Davenport, the movement had a center for research and propaganda. Across the nation innumerable organizations formed to propagandize for eugenics or secure specific eugenic goals.

Eugenics had a broad and significant influence upon such varying movements as peace, prohibition, and birth control, but its major impact came in three specific areas. One was the campaign to lift the burden of feeblemindedness, insanity, and criminality through sexual sterilization, permanent custodial care, and restriction of marriage. A special goal was to halt the supposed menace of the feebleminded, for many eugenists believed that mental defect underlay much of the nation's crime, prostitution, and pauperism. Eugenics, in addition, supplied biological justification for many racists whose efforts to prevent immigration of "inferior" peoples from southeastern Europe culminated in the restrictive legislation of the 1920's. Finally, eugenics inspired research in many fields: biologists and physicians investigated the inheritance of mental and physical diseases, criminologists traced the hereditary background of crime, psychologists studied the intelligence of individuals, classes, and races, and demographers plotted the birth rates of the various groups in society.

Out of these activities emerged a pessimistic eugenics creed that was racist, conservative, and anti-democratic. Because they believed that social classes reflected innate ability, eugenists feared that the low birth rate of the upper classes meant the nation was being replenished by its poorest stock. They lamented that democracy gave political power to the incompetent and that government welfare measures permitted the lower classes and races to survive and breed. From the beginning, however, the conservative interpretation met criticism within the movement and without. By 1930 the criticisms and new developments in many fields of science exposed the fallacies and prejudices that had dominated much of the early movement. After 1930 eugenics in America declined in influence and, at the same time, became increasingly modest and scientific in its orientation.

Microfilm $5.30; Xerox $18.80. 416 pages.

THE SIGNIFICANCE OF RICHARD HATHAWAY EDMONDS AND HIS MANUFACTURERS' RECORD IN THE NEW SOUTH

(L. C. Card No. Mic 59-6101)

Yoshimitsu Ide, Ph.D.
The University of Florida, 1959

This is a study of Richard Hathaway Edmonds and the weekly magazine he founded in 1882, for the purpose of promoting the industrialization of the South. Edmonds was born in 1857 at Norfolk, Virginia, and passed his youth on a small farm in Lancaster County. In 1871 he moved to Baltimore, where he became a reporter and later assistant editor of the Journal of Commerce, a free-trade commercial paper. While working for the journal, he took a trip through a portion of the South and was struck by the poverty of Southern farmers. He thought it was caused by the lack of urban markets for agricultural products. Moreover, he was deeply impressed by the booming prosperity of the Birmingham area and the growth of the cotton textile industry in the South. It was during this period that his idea of Southern industrialization developed.

In 1882 Edmonds established his own paper, the Manufacturers' Record. Amidst the political confusion and the economic suffering of the post-Civil War period, realizing the wealth of Southern resources and grasping their possibilities, Edmonds, as editor of the Record, planned and labored for the industrialization of the South. He became nationally and internationally known as one of the leaders of the "New South Movement." Other prominent ones were Henry W. Grady of the Atlanta Constitution, Francis W. Dawson of the Charleston News and Courier, and Daniel A. Tompkins. Grady and Dawson both died in 1889 and Tompkins in 1914, but Edmonds lived until 1930. Consequently his career embraces better than any other all of the New South Movement.

After describing the rise of the New South idea and the founding and growth of the Manufacturers' Record, the dissertation analyzes Edmonds' ideas in regard to the major economic problems faced by the post-Civil War South. Although the Record discussed "all subjects dealing with the economic life of the South and with its general welfare," the dissertation especially studies what the

Record had to say about iron industries in the South, the tariff, cotton and cotton mills, white Southern labor and the union movement, Negro and immigrant labor, capital and banking, and transportation. It becomes apparent that while Edmonds' economic philosophy was basically that of Northern industrialism, so much so that he rejected without hesitation such widespread Southern ideas as reliance on cotton cultivation and free trade, still his opinions were often much influenced by conservative and traditional Southern ideas. For example, his strong prejudices against Negro and immigrant labor and the union movement were mainly based upon his firm belief in the superiority of the Anglo-Saxon race.

Although the Manufacturers' Record continued its publication after Edmonds' death, it rapidly lost its peculiar personality and energy as the enthusiastic promoter of the South's industrialization. It was eventually merged with another magazine, and it then undertook to promote the economic interests of the nation as a whole, rather than continuing to emphasize those of the region Edmonds and his Manufacturers' Record had done so much to strengthen. Microfilm $4.65; Xerox $15.60. 364 pages.

THE MISSION OF THE DUKE OF MONTEBELLO IN ST. PETERSBURG, 1859-1861.

(L. C. Card No. Mic 59-4635)

John Hjalmar Jensen, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Lynn M. Case

The rapprochement between France and Russia after the Crimean War is still an obscure area in nineteenth century European diplomacy. Though the gestures of friendship between these powers in 1856 and 1857 are well known, as is the antagonism which replaced this friendship as a consequence of the French attitude during the Polish insurrection of 1863, the practical results of this relationship in the period 1859-1861 require further study. Until the Russian government permits the examination of the czarist documents in this period, much of this obscurity will remain. However, in the past thirty years, a number of collections of materials bearing on this problem have become available in France, Britain, Austria, Germany, and Italy. The objective of the present study is to focus attention on one of the key figures in this relationship, the Duke of Montebello, who was France's ambassador at St. Petersburg from 1858 to 1863.

By using the sources recently made available to study the activities, views, and influence of this diplomat, the author has endeavored to explain more fully the examples of conflict and co-operation in French and Russian relations in the period 1859-1861. The most valuable collections used in this task were the French foreign ministry correspondence, the Montebello-Thouvenel private correspondence, the Russell and Cowley papers in the British Public Record Office, and the private and official correspondence with St. Petersburg in the Austrian Haus-, Hof-, und Staatsarchiv, Vienna.

The two major problems facing Montebello in this period were the unification movement in Italy and the Russian determination to regain their dominant position at Constantinople. The duke took a negative stand on both of these issues. He was conservative and pro-papal in his views on Italy. Thus, he tried to obtain Russian support for a conservative Italian policy. While warning his home government that Russia's friendship might be lost by a nationalistic Italian program, he led the Russians to believe that this was the sort of policy which Napoleon really wanted and that Russian urging would confirm his good intentions. In the Austro-Sardinian war period and during the preparations for a European congress to consider the settlements of Villafranca and Zurich, he followed this line consistently. When the brochure, Le Pape et le Congrès, and the resignation of Count Walewski in January 1860 demonstrated that France would not interfere with Sardinia's annexation plans, he explained this acquiescence as an effort to bar further revolutionary changes. At the same time, he gained Russian assistance against British efforts to block the French annexation of Nice and Savoy. In the spring and summer of 1860 he bent every effort to influence his government to act against the Italian unitary developments.

The Russian price for co-operation in Western Europe was negotiation on the Eastern question. The ambassador's views on this issue were strongly opposed to any French commitments, yet he was forced into supporting the Russian proposals in the East in order to maintain a close relationship which he could hope to exploit in Italian affairs. When the conservative German monarchs met with the Russian czar at Warsaw in October 1860, the Russians opposed any plans to revise the Italian situation or to form a cordon sanitaire against France on the strength of promised arrangements on the Eastern question and pledges of conservative policy elsewhere which Montebello had obtained from Napoleon.

Nevertheless, Russia was too weak and Montebello was too unsympathetic to her main interests and to French policy in Italy, for such co-operation to be lasting or fruitful. Microfilm $5.40; Xerox $19.00. 424 pages.

THE AMERICAN MISSIONARY ASSOCIATION, 1846-1861: A STUDY OF CHRISTIAN ABOLITIONISM.

(L. C. Card No. Mic 59-5561)

Clifton Herman Johnson, Ph.D.
The University of North Carolina, 1959

Supervisor: Professor Fletcher M. Green

This is a study of the formation of the American Missionary Association and its missionary and anti-slavery activities before the Civil War. After long and almost fruitless efforts to influence the Protestant churches and missionary societies of the United States to adopt the principle of no fellowship with slaveholders, a convention of evangelical abolitionists assembled in Albany New York on September 2, 1846, and established the American Missionary Association. This organization refused to accept gifts from slaveholders and endeavored to propagate the doctrines of a pure and free Christianity by gathering and sustaining mission churches in the

United States and in heathen lands that excluded the practices of caste, polygamy, slaveholding, and all other public, as well as private, sins. With offices in New York City, and operating under a charter granted by the state in 1849, the A. M. A. was an independent, non-sectarian, and non-ecclesiastical body, with membership open to any contributor to the treasury who was a professing Christian of evangelical and abolitionist sentiments. Soon after its organization, the Association absorbed the Union Missionary Society, the Committee for West Indian Missions, and the Western Evangelical Missionary Society. Its leadership was supplied largely from the ranks of the American and Foreign Anti-Slavery Society, and it was an ally of that organization in the anti-slavery crusade. It also maintained an intimate connection with the officers and faculty of Oberlin College, and more than one-third of the missionaries appointed during the ante-bellum period were former Oberlin students. Its financial support came chiefly from New England, the Middle West, and New York, and largely from Congregationalists, Free Presbyterians, and Wesleyan Methodists, although there was some support from other regions and from members of other evangelical denominations.

Between 1846 and 1861, the period covered by this study, the A. M. A. established and sustained missions in West Africa, Jamaica, Siam, Hawaii, and Egypt, and among the Ojibway Indians in Minnesota and the fugitive slaves in Canada, and supported 263 home missionaries located in the Northeast, the West, Kentucky, Missouri, North Carolina, and the District of Columbia. Increasing attention was given to home operations after 1850, and the Association was supporting 112 home missionaries in 1860. A most significant development of the decade preceding the Civil War was that the Association evolved from a missionary society based on anti-slavery principles into an aggressive abolition society, which resulted in enlarged operations in the South and in special attention being given to Kansas. Throughout the ante-bellum period, however, the Association retained its fundamental evangelical character, endeavoring to bring about the abolition of slavery by winning converts to a religious fellowship that condemned the institution as un-Christian, and continued its foreign activities and the work of promoting anti-slavery and reformatory evangelical churches in the free states. Meanwhile, the Association was establishing its reputation as a friend of the slaves and preparing itself for the later, but unforeseen, task of bringing education and religious leadership to the Southern Negro, a work which began in 1861 and has been continued to the present time.

This study is based largely on the materials in the American Missionary Association Archives in the Fisk University Library in Nashville, Tennessee. This manuscript collection of approximately 200,000 items covering the period from 1839 to 1878 includes reports and letters from the missionaries and other miscellaneous correspondence and papers of the A. M. A. Complete files of the printed Annual Reports, and the official organs of the Association, the American Missionary and the American Missionary Magazine, which were published monthly, have also been used. Other manuscript collections used include the American Home Missionary Collection in the Chicago Theological Seminary Library, the G. S. Miller Collection of Gerrit Smith papers in the Syracuse University Library, the Berea-Fee Collection in the Berea College Library, and the Oberlin College Treasurer's Papers in the Oberlin College Library. Extensive use has also been made of contemporary religious and anti-slavery periodicals. Microfilm $7.55; Xerox $25.80. 595 pages.

JOHN CAPODISTRIAS AND THE MODERN GREEK STATE

(L. C. Card No. Mic 59-6975)

William Peter Kaldis, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Chester V. Easum

John Capodistrias was born on the island of Corfu, February 11, 1776. After receiving his education at the University of Padua, he returned to his homeland where he became an official of the newly formed Septinsular Republic. From the moment when he made his initial appearance in the service of the Septinsular Republic, 1803, to the year of his death, 1831, Capodistrias was confronted with important political tasks. In 1808 he left Corfu in order to accept an invitation to join the diplomatic staff of the Emperor Alexander I of Russia. There, in Russia, he served loyally and competently until his resignation in the year 1822. He subsequently returned to private life and lived in the city of Geneva where he was constantly besieged by Greeks asking for his assistance in the Greek War of Independence. He remained in Geneva until the Spring of 1827 when the Greek National Assembly, meeting at Troezene, elected him President of the newly liberated Greek state. In January, 1828, he landed in Greece, and he served as Greece's president until his assassination in October, 1831.

Greece had been under the domination of the Ottoman Turks for more than three hundred and fifty years. In 1821 the Greek people rose in revolt. After seven years of bitter fighting, a period which witnessed civil war within the nation, the Greek state was finally liberated from the Turks. President Capodistrias was confronted with the task of molding the Greek people into a political entity. Toward this goal he instituted a series of administrative reforms which laid the foundation of the modern Greek state.

The writer has placed emphasis on the administration of Capodistrias during the years of his presidency and on the leadership which he provided in governing the Greek nation. Further, the writer has described the machinery of government in Greece during the Ottoman domination and the period of the Greek War of Independence. In order to evaluate Capodistrias's achievements as an administrator, it is necessary to review the machinery of government which existed before his time.

Previous writers on Capodistrias failed to agree when evaluating his administration: some call him a tyrant, others call him a saviour. The present writer was fortunate in being able to examine much of the archival material relating to this period which had previously been uncatalogued, therefore inaccessible. His conclusions fall somewhere between these points of view.

Microfilm $2.95; Xerox $10.00. 225 pages.

THE HISTORY OF THE MODERN PENTECOSTAL MOVEMENT

(L. C. Card No. Mic 59-6715)

Klaude Kendrick, Ph.D.
The University of Texas, 1959

Supervisor: Barnes F. Lathrop

The beginning of the twentieth century gave birth to a religious revival that was soon to spread throughout the United States. Due to the emphasis placed upon a distinctive religious experience, the baptism in the Holy Spirit received with the phenomenon of "tongues" like that witnessed by the Apostolic Church on the day of Pentecost (Acts 2:1-4), the revival became known as the modern Pentecostal movement.

The new order began in 1901 at Topeka, Kansas, when Charles F. Parham and a group of his students concluded that "tongues" were the Bible evidence of the baptism in the Holy Spirit. Under Parham's leadership a crusade was immediately launched to spread the new doctrine. By 1905 congregations of Pentecostal converts had been established in Kansas, Missouri, Oklahoma, and Texas. After 1906, when Los Angeles became the center of the revival, the scope of the movement became both national and international in character.

After 1910 the Pentecostal bodies could be classified as either "baptistic," those that believed sanctification to be imputed with salvation, or perfectionist, those that held sanctification to be a second definite religious experience of grace. The baptistic congregations had no organic connection with any religious group in the early years of the revival. Very shortly it became evident, however, that some type of constitutional authority was needed if these bodies were to realize even a remote uniformity, maintain high standards of discipline, and benefit from cooperative enterprises. Consequently an organizing trend began that resulted in the establishment of the Assemblies of God in 1914 at Hot Springs, Arkansas. This quasi-congregational group with headquarters in Springfield, Missouri, developed into the largest Pentecostal organization, having an adult membership of nearly one-half million.

Other prominent baptistic bodies considered in the study are the Pentecostal Church of God of America, Joplin, Missouri, founded in 1919 by a group of ministers who thought the Assemblies of God was assuming too much central authority; the International Church of the Foursquare Gospel, Los Angeles, California, established as a consequence of the spectacular ministry of Aimee Semple McPherson; the Open Bible Standard Church, Des Moines, Iowa, formed by the amalgamation of the Bible Standard Church, Eugene, Oregon, and the Open Bible Evangelistic Association, Des Moines, Iowa; and the United Pentecostal Church, St. Louis, Missouri, the largest unitarian Pentecostal group in America.

The perfectionist bodies developed when some established Holiness sects accepted Pentecostal theology after 1906 and continued to operate as Pentecostal groups. The Pentecostal Holiness Church, Franklin Springs, Georgia, was formed when the Holiness Church and the Fire-Baptized Holiness Church merged in 1911. The Church of God, Cleveland, Tennessee, was a small local Holiness group centered largely in Tennessee and North Carolina until 1908, when it became national in scope after embracing the Pentecostal doctrinal tenet. The Church of God in Christ, Memphis, Tennessee, is the largest Negro Pentecostal church in America. Its development has been closely connected with the ministry of C. H. Mason, the most prominent leader of the body through the years.

Because the Pentecostal groups are somewhat exclusive by nature, they have not been too free in their association with other Christian communions. In recent years, however, a favorable trend toward cooperative action has developed. This is indicated by the forming of the World and North American Pentecostal Fellowships and the participation of a number of the Pentecostal bodies in the National Association of Evangelicals.

Pentecostals are fast taking their place among the historical churches. This fortunate development will no doubt result in better understanding and accomplishment of common goals.

Microfilm $4.95; Xerox $16.60. 388 pages.

A SOCIAL HISTORY OF INDUSTRIAL GROWTH AND IMMIGRANTS: A STUDY WITH PARTICULAR REFERENCE TO MILWAUKEE, 1880-1920.

(L. C. Card No. Mic 59-5789)

Adolf Gerd Korman, Ph.D.
The University of Wisconsin, 1959

Supervisor: Howard K. Beale

An attempt has been made to explore some of the social relationships between immigrants and American industrial growth from 1880 to 1920. Since certain of the problems involved could not be readily handled in detail for the national scene, the first part of this study deals with Milwaukee. Here an attempt has been made to describe and analyze some aspects of the relationship: the local labor market, occupations and residence, and internal factory life. Other aspects of the relationship required moving out from the local community; for such matters as protective labor legislation, welfare work, the industrial safety movement, and the Americanization crusade were of national scope.

Much of the information on the local scene has come from quantitative data based on such sources as the manuscript census, the city directory, factory inspection reports, and payroll books. On both local and national levels, literary materials in publication and in manuscript collections have been used. The combinations of these quantitative and literary materials has laid the methodological ground work for studying some aspects of social history that have long been considered the province of the sociologist, rather than of the historian.

Immigrant groups that came to Milwaukee in large numbers for the first time after the Civil War found it necessary to enter an industrializing economy that had already become ethnically stratified. Their homes were usually found in the areas of industrial sites. They showed little upward mobility in the occupational ladder; higher supervisory positions inside factories were usually closed to them between 1880 and 1905.

Immigrants were usually treated as workingmen, rather than as immigrants who required special handling.

For the most part employers made little effort to affect the ethnic composition of their work force; their concern was with production rather than ethnology. Changes in the handling of immigrants did not result from greater concern about them as foreigners. Instead the new methods came from changes taking place in the handling of labor. The industrial safety movement, in conjunction with workmen's compensation appears to have stimulated elaborate welfare work already begun by a number of firms. Employers concerned with developing company loyalty, efficiency, and harmonious relationships between themselves and workers incorporated safety work into their programs. Men concerned with the state's responsibility for improving the conditions of employment used factories as wedges for furthering broader social reforms. By 1914 safety and welfare workers had already developed special techniques to reach immigrants with the safety message.

Gaining in strength about the same time, movements to Americanize the immigrant also sought to take advantage of the strategic place of factories for "educating" immigrant workers. Americanizers linked this effort to the "humanizing" trend in industry. During World War I numerous factories became instruments of the Americanizers, but basically, employers' interests remained rooted in industrial rather than patriotic considerations, and hence after the war Americanization work in factories ceased. Microfilm $6.35; Xerox $22.00. 500 pages.

RAILROADS AND RECONSTRUCTION IN NORTH CAROLINA 1865-1871

(L. C. Card No. Mic 59-6442)

Charles Lewis Price, Ph.D.
The University of North Carolina, 1959

Supervisor: Fletcher M. Green

At the end of the Civil War the railroads of North Carolina were badly damaged and inoperative. Almost immediately plans were drawn up for the restoration of the system. Temporary repairs were made, and within a few weeks trains were again moving. In the following months permanent rebuilding and reequipment of the roads were accomplished. By 1868 all but two railroads were physically reconstructed. Financial reconstruction took place along with the physical rebuilding of the roads. Through the patience of the creditors and the close cooperation of the bondholders the chaotic finances were readjusted and debts were refunded with only one company being forced into bankruptcy.

The United States Army reconstructed a few lines during the closing weeks of the war and operated these as military railroads for six months. Upon the return of the roads the army sold the companies a large amount of equipment. While the army made some contributions, military operation of the railroads delayed reconstruction and the return to normal traffic channels. The railroads would have been far better off if the United States Army had marched out of the state upon the surrender of the Confederate armies.

Not content merely to rebuild the prewar railroads, North Carolinians planned further extensions. Lacking private sources of capital, railroad promoters turned to the state for financial aid. Few legislators dared oppose railroad bills lest they lose support for their own pet project, and consequently millions of dollars were appropriated. State credit was ruined when the legislature failed to increase taxes sufficiently to pay the interest on the bonds issued.

State aid was tied to political control of the railroads, and party faithfuls were rewarded by railroad appointments. Political control of the railroads combined with the extravagant appropriations proved fertile ground for fraud and corruption by members of both parties. Corruptionists used political influence to secure control of the railroads and thereby won control over the vast state appropriations. The master mind behind much of this corruption was George W. Swepson who conceived of a grandiose plan for a railroad empire based upon control of the railroads of North Carolina. The schemes of Swepson and other corruptionists failed when they lost huge sums during the panic of Black Friday.

Political reaction to the bond frauds led to the repeal of the railroad legislation by the same legislature which had passed it. The Republican Party was blamed for the extravagance and corruption, and the Conservatives won control of the legislature in 1870, thus ending Radical Reconstruction in North Carolina. The bond frauds also brought an end to state aid to the railroads. Thereafter railroads promoters turned to northern financiers for capital. With northern money came northern control. Thus commenced a new era in the railroad development of North Carolina. Microfilm $8.00; Xerox $27.20. 630 pages.

THOMAS CROMWELL AND THE HENRICAN REFORMATION

(L. C. Card No. Mic 59-5219)

Theodore Roszak, Ph.D.
Princeton University, 1958

This is a study of the religious policy of Thomas Cromwell during the years 1532-1540. Cromwell is usually portrayed by historians as a conscienceless, Machiavellian politician whose "policy" was little better than a matter of pandering to his king's ambitions and filling his own pockets. This study seeks to displace this empty characterization of Cromwell with that of a man whose intellect, character, and religious beliefs were definite and solid enough to generate consistent, far-reaching policy. This is, in brief, a work of revision. In a lesser way, it seeks to contribute to Cromwellian biography a new conception of Cromwell's personality. In a larger way, it seeks to contribute to the history of the Henrican Reformation by presenting the religious developments of that period as the results of Cromwell's policy.

The study opens with a brief sketch of Cromwell's rise to power and a preliminary estimate of his character and religious disposition. Emphasis is placed on Cromwell's social origins, for it is a main idea of this thesis that he was the spokesman for the values and beliefs of middle-class Englishmen.

Cromwell's first chance to make policy on a religious problem was Henry VIII's divorce. His influence on divorce policy is traced in detail into late 1533, and it is suggested that he more than any single person developed the idea and policy of schism with Rome.

Basic to the rest of the study is the problem of Cromwell's relationship with Henry. This is taken up and the conclusion reached that Cromwell held more control over policy-making during the 1530's than the king.

The familiar institutional reformation of the church during 1534-36 is briefly reviewed, and Cromwell's contributions noted. As part of this subject, the office of the vicar-generalship, Cromwell's key religious office in the schismatic church, is analyzed and its development in his hands is described.

Following these institutional changes, Cromwell's influence on the doctrinal reformation of the church during 1534-40 is studied. Cromwell is presented as the organizing mind behind an active corps of reformers. The idea is developed that the driving force behind his religious policy was his desire to create a grand Protestant alliance against Catholic Europe. This early experiment in religious diplomacy is made central to the history of the 1530's in England, and doctrinal reform is closely correlated with it. Cromwell's fall from power is shown to be a direct result of this religious policy.

The study concludes with an analysis of Cromwell's religious state of mind and the motivations behind his policy.

This dissertation makes use of the usual printed sources for the reign of Henry VIII, as well as microfilm reproductions of books and pamphlets of the period. The Folger Library in Washington, D. C. was consulted and yielded several useful Henrican books and tracts. The study draws heavily upon the Letters and Papers of Henry VIII because the bulk of that excellent calendar for this period is made up of the Cromwell papers. This and Roger Merriman's complete edition of the Cromwell letters make up the backbone of the study. For German affairs, the Corpus Reformatorum, the appendix of state papers in Friedrich Prüser's England und die Schmalkaldener, and the letters of Martin Luther were used.

Microfilm $3.85; Xerox $13.00. 300 pages.

THE ROLE OF RUTH ST. DENIS IN THE HISTORY OF AMERICAN DANCE, 1906-1922.

(L. C. Card No. Mic 59-4428)

Christena Lindborg Schlundt, Ph.D.
The Claremont Graduate School, 1959

This dissertation began as merely an account of the career of the American dancer, Ruth St. Denis. As the study progressed, however, it became obvious that the professional life of Ruth St. Denis had meaning in American history far beyond the limits of her own career. It was at this point that a theory of Dixon Ryan Fox was found applicable to St. Denis' career. In an essay entitled "Civilization in Transit" (published in Dixon Ryan Fox, Ideas in Motion, New York, 1935), Fox theorized that the transfer of civilization (the arts and sciences) from Europe was complete when an art or science was performed by natives in America and taught by natives in American schools sufficiently developed to maintain themselves without help from Europe.

In applying this theory to the history of dance in America, the author found that the institutionalization of dance as an art form in America occurred during the dancing career of Ruth St. Denis, specifically during the first part of her career from 1906 to 1922. It was further found that Ruth St. Denis was the greatest single element in this domestication of dance in America. In 1906, there were no schools of dance in America; only a few foreign teachers taught ballet in the large cities. By 1922, a national dance school existed that had native teachers: Denishawn School, The Ruth St. Denis School of Dancing and its Related Arts. In 1906, there were no concert companies of dancers touring in the United States; in 1922, the Denishawn Dancers made the first of many national tours. Through the continuity of the career of Ruth St. Denis, an American school of dancing had been organized, and an American dance company was touring.

Finally, this study found that the unique personality of Ruth St. Denis, a combination of earthly beauty and unearthly spirit, was an essential element in causing this domestication to occur. For Fox further conjectured that an individual may consciously perform the function of domesticating an art. This individual, he observed, was most effective when not much unlike the people reached. It was found that Ruth St. Denis was more effective than other dancers because she epitomized the middle class ideal: a tall, beautiful, Anglo-Saxon women, with impeccable morals, a high religious tone, intense patriotism, and noble thoughts.

This study also applies to the history of dance in America what Fox called the second law of transit of the arts or sciences: that civilization, generally speaking, declined when it struck the frontier in which it was to be accepted. But while the art or science changed somewhat, that fact of appeal to the masses of people caused it to be diffused more widely, thus laying a broad basis for the culture that came after it. So with art dance in America, this study shows. It chronicles the vulgarization of dance, specifically of art dance as it was forced to adjust to its only outlet, vaudeville. This process of vulgarization was essential for art dance to survive in America. Its appeal to the masses, however, caused it to be diffused into the smallest village in America. It was Ruth St. Denis who caused this diffusion more than any other dancer. She presented her art on vaudeville stages almost constantly during the years 1906 to 1922, and by so doing she raised the level of taste in this country. When she moved permanently to the concert stage in the 1920's, America was ready to accept art dance. Thus it was she who helped lay the broad basis of dance audience for the dancers, foreign and domestic, who came after her on the concert stage.

Microfilm $2.85; Xerox $9.80. 218 pages.

THE ORIGINS AND ESTABLISHMENT OF THE PRESBYTERIAN CHURCH IN THE UNITED STATES

(L. C. Card No. Mic 59-6451)

William Junius Wade, Ph.D.
The University of North Carolina, 1959

Supervisor: Fletcher M. Green

The Origins and Establishment of the Presbyterian Church in the United States is an analysis of the basic reasons for the separation of Southern Presbyterians in 1861 from the national church organization and the story of the church's work and development to 1870. Before the Civil War there was a firm desire among Old School Presbyterians to maintain national church unity. Southern Presbyterians, outside of South Carolina, earnestly desired a peaceful settlement of sectional issues during the secession crisis. The coming of the Civil War convinced Southern Presbyterians, however, that church unity could no longer be maintained. A separation had begun in fact with the failure of Southern delegates to attend the Philadelphia General Assembly. The passage of the Spring resolutions, which required Presbyterians to give allegiance to the Federal government, by that body led Southerners to feel that immediate and formal separation was imperative. The organization of the Presbyterian Church in the Confederate States of America was completed at the Augusta General Assembly in December, 1861.

The ministers of the church were as a body loyal to the Confederacy. Outside of East Tennessee, there was no appreciable sentiment hostile to the new government. The formation of the Southern church and the Confederacy were so closely linked in time and cause that loyalty to state and church were closely associated. The church generally upheld the formation of the Confederacy as a part of God's plan and early in the war assured its members that the South would be victorious. In the latter years of the war Southern defeats caused the ministry to warn that God was punishing his people because of their sinfulness, but ministerial conviction that the outcome of the war was in God's hands did not waver.

In every phase of its early existence the church was greatly affected by the war. Foreign missionary activities abroad could not be carried on because of the Northern blockade, but some work was carried on among the Indians. Benevolent work among the slaves was never given the proper emphasis because in the confusion of war the church was unable to agree on what attitude to take toward the Negro. Gradually the ministry came to feel that missionary operations in the army was its most important wartime obligation. An efficient chaplains corps was established in 1863, but it had been preceded by a period in which the church was shamefully negligent of the interests of the army.

The major problem of the Southern church after the defeat of the Confederacy was the preservation if its separate existence in the face of Northern hostility and determination to recover the Southern field. Church reunion might have been possible had the Northern Assembly not followed the Spring resolutions with a series of political statements during the war. In 1865 the Northern Assembly determined to readmit Southern Presbyterians only upon the promise of adherence to the union and confession of guilt in secession and the establishment of the Southern church. These terms stiffened Southern resistance and were a major factor in the permanent organization of the Presbyterian Church in the United States. The Northern Assembly sent missionaries to the South, but, outside of East Tennessee unionists and a few Freedmen in the Carolinas, the missionaries won little support. By 1870 the permanent character of the Southern church was assured. Microfilm $6.55; Xerox $22.80. 516 pages.

THE INFLUENCE OF CERTAIN GRAPH VARIABLES ON SUITABILITY OF GRAPHS FOR VARIOUS INTERPRETIVE OPERATIONS

(L. C. Card No. Mic 59-5766)

Thomas Gobaton Flores, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Richard D. Powers

Graphs are generally used whenever statistical data need to be presented in a concise and clear form. The study was undertaken, therefore, to determine the suitability of different graph forms for specific interpretive operations.

Twenty-five standardized graphs, each with a set of six to seven questions, were given to 107 Short Course students at the University of Wisconsin and 548 high school students from Wisconsin and Ohio. A t-test of difference between proportions was applied to the data to determine whether to accept or reject the hypotheses that different pairs of graphs did not differ in regard to ease of comprehension and in the performance of the different interpretive operations.

Results showed that some graph variables were definitely more suitable than others for specific interpretive operations. Among the more striking results were the following:

1. For estimating totals, bar graphs were much better than line graphs. Segmented graphs were significantly easier to interpret than grouped graphs.
2. Elements that originated at the base line were decidedly easier to estimate than elements that did not.
3. Segmented bar graphs were definitely superior to segmented line charts (surface charts) for estimating the quantity of an element originating at a point other than zero.
4. Grouped-type bar and line graphs were highly

superior to segmented graphs for estimating lengths of two different elements in the same unit.

5. For estimating lengths of two similar elements in different units, symbols were definitely better than a key in circle graphs. Bar graphs were also more suitable than line graphs.

6. Bar graphs were significantly better than line graphs for estimating lengths of different elements in different units. In general, figures on the elements did not make them easier to read.

7. Bar graphs were also decidedly better for estimating difference between two unlike elements in different units. Microfilm $2.55; Xerox $8.80. 193 pages.

A STUDY OF ASSOCIATED PRESS, INTERNATIONAL NEWS SERVICE, AND UNITED PRESS REPORTS OF ATTENDANCE AND REACTIONS OF CROWDS AT APPEARANCES OF EISENHOWER, STEVENSON, NIXON, AND KEFAUVER IN THE 1956 PRESIDENTIAL CAMPAIGN.

(L. C. Card No. Mic 59-5652)

Bryce Wilson Rucker, Ph.D.
University of Missouri, 1959

Supervisor: Earl F. English

Newspapers have been accused of being biased for or against candidates and political parties during every presidential campaign this century. Most of this criticism has been of news presentation, rather than editorial comment. Because most newspapers receive their campaign coverage from one of the national news services, it was felt desirable to study some phase of the news services' reporting.

This study concerned itself with the three major news services' reporting of sizes of crowds and the ways in which crowds acted at the appearances of Eisenhower, Stevenson, Nixon, and Kefauver during the 1956 campaign. Crowd reporting offered an opportunity to determine the extent to which news services differed in their treatment of a subject which lends itself to subjective interpretations.

Ten major appearances of each candidate were designated. Crowd statements were abstracted from the three news services' reports of these appearances. They were submitted to thirty judges who rated each set of statements for each story on a scale of eleven values, ranging from "most unfavorable" to "neutral" to "most favorable" toward the story subject. Statements did not identify candidates, political parties, or news services.

The twenty men and ten women judges were selected in such a way as to obtain a cross section of raters. All had completed at least one college degree. Sixteen employment specialties and eighteen states were represented.

Judges were alerted to certain common systematic errors which they should avoid in evaluating sets of statements.

Analysis of variance, chi square, t test, and q measure of dispersion statistical techniques were applied to the data in an effort to measure differences in favorableness as ascertained by the judges. Runs tests and z tests made it possible to determine if one news service estimated sizes of crowds as being larger or included more crowd reaction information than did the other two.

International News Service was found to be most favorable in its crowd reporting toward Eisenhower; Associated Press, second most favorable; and United Press, third most favorable. United Press was most favorable toward Nixon; Associated Press, second most favorable; and International News Service, third most favorable.

Associated Press was most favorable toward Stevenson; International News Service, second most favorable; and United Press, third most favorable. International News Service was most favorable toward Kefauver; Associated Press, second most favorable; and United Press, third most favorable.

This inequal treatment by the three news services was not always clearly political. United Press and Associated Press tended to be more favorable to the two Republican candidates than to the Democratic candidates, although findings in relation to Associated Press' reports of the vice presidential candidates' appearances were not at significant levels of confidence. International News Service was not favorable to either party.

United Press reports were more "neutral" than were those of the other news services and devoted less space to crowd reporting, except in coverage of Nixon appearances. Associated Press carried the most statements about crowds; International News Service included the second largest number of crowd statements.

International News Service generally estimated sizes of crowds as being larger than did the other two news services. Associated Press gave the second largest estimates of crowds and United Press, the smallest crowd estimates.

Certain trends in favorableness also became evident as the campaign progressed. Associated Press' crowd reports became more favorable to Stevenson and Nixon and less favorable to Kefauver. United Press' reports became more favorable to Eisenhower and Nixon and less favorable to Stevenson. International News Service's crowd reports became less favorable toward Eisenhower and Nixon. Microfilm $3.70; Xerox $12.60. 286 pages.

LANGUAGE AND LITERATURE, GENERAL

NON-HISTORICAL AND LEGENDARY ELEMENTS IN THE GESTA REGUM ANGLORUM OF WILLIAM OF MALMESBURY

(L. C. Card No. Mic 59-3009)

Esther K. Birdsall, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Franklin D. Cooley

The so-called lost literature of mediaeval England has engaged the attention of several scholars. Their quest led them into the histories of the twelfth century in an effort to reconstruct the content of the lost vernacular literature. This study is in the same tradition and differs from the preceding ones in that it is limited to the non-historical and legendary elements in the Gesta Regum Anglorum of William of Malmesbury.

Legends and non-historical elements of the first book discussed in the second chapter afford an excellent opportunity for studying William of Malmesbury's methodology because most of the sources are extant. A careful study reveals that his deviations were not based on oral vernacular sources but on classical writings, such as the Aeneid and the Lives of the Twelve Caesars.

Legends pertaining to the English form 871 to 1066 also reveal William of Malmesbury's interest in and dependence on classical tradition. Great kings like Athelstan may have been commemorated in vernacular poems and sagas, but in the Gesta Regum Anglorum some of them emerge as epic heroes. Although not all of them were accorded full epic treatment, several of them have definite heroic associations, such as visions, speeches inciting men to battle or to flight, and heroic thrusts. Because all of these details were well known in classical and Germanic literature, they cannot be utilized to prove or disprove the theory that oral vernacular tales are preserved in the Gesta Regum Anglorum.

Because legends pertaining to the Normans and the Conquest are so few in number, they do not assist much in a study of this nature. Although the story of the death of William Longsword is probably based on a lost chanson, most of the tales departing from known sources have classical analogues. For example, the dream of William the Conqueror's mother, and the Conqueror's stumbling upon touching English soil were inspired by similar accounts in the work of Suetonius.

More important are the miscellaneous legends discussed in chapter five. First, they reflect the literary tastes of early twelfth century readers. Secondly, some of them contain such details as compacts with the devil, human automata, and betrothals to statues which were not too common in western mediaeval Europe at the time. Because no direct sources have been found for most of these tales, one assumes that they were based on stories transmitted by traveling monks. Being interested in good stories, William of Malmesbury recorded these floating traditions for the entertainment of his readers.

As the summary in chapter six indicates, the non-historical and legendary elements in the Gesta Regum Anglorum cannot be utilized to reconstruct the content of the lost vernacular literature of mediaeval England. However, they are important because they heighten William of Malmesbury's role in the transmission of legends not for the sake of edification but for their intrinsic literary merits and thus place him among the more important contributors to the twelfth century renaissance.

Microfilm $2.65; Xerox $9.20. 204 pages.

GEORGE CHAPMAN'S PHILOSOPHY AND TREATMENT OF LOVE

(L. C. Card No. Mic 59-4302)

Frances Jahrling Chivers, Ph.D.
The University of Buffalo, 1959

The primary purpose of this dissertation has been to show what George Chapman's philosophy and treatment of love are by making a thorough study of certain of his works. The texts which have been selected for careful study have been: Hero and Leander, Bussy D'Ambois, and The Revenge of Bussy D'Ambois. This selection has been made because these texts happen to be especially rich in love relationships, because Chapman's Hero and Leander has been a much neglected poem, because Chapman criticism has traditionally presented what I have considered to be a mistaken interpretation of Bussy D'Ambois, and because the other tragedies of Chapman contain almost no love relationships. Limitations of space have necessitated exclusion of Chapman's comedies.

Commonplace Elizabethan ideas of love have been discussed and it has been shown that they were shaped primarily by the Neoplatonism of the Florentine Academy, particularly by the Commentarium in Convivium Platonis of Marsilio Ficino. It has been shown that George Chapman is one of the most orthodox and typical writers of his age in his whole approach to love and that commonplace ideas on love and the psychological terms in which love was usually spoken of appear constantly in his work. Particular attention has been called to his use of the influential doctrine of the three degrees of knowledge and their corresponding grades of love, a doctrine which has been shown to be present in Ficino's Commentary, in Castiglione's Courtier, and in many familiar Elizabethan dramas. The historical importance of Ficino as a philosopher of love has been explained, and estimation of how Ficinian or Unficinian certain aspects of Chapman's philosophy and treatment of love are has been made a secondary purpose of this dissertation.

Chapman's essentially didactic approach to life and literature has been shown to be an attitude common to his

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

age. The underlying purpose of his life's work has been explained as a program designed to improve man's capacity for love. It has been shown that the Neoplatonic love philosophy and psychology are basic to his theories of how helpful learning, poetry, religion, work, and marriage can be to man in facilitating his ascent of the Platonic ladder. This ascent has been shown to be the central concern of renaissance men influenced by Neoplatonism.

Some introduction to renaissance thought on love and to Chapman's use of the commonplace Neoplatonic love philosophy and psychology having been provided, detailed analysis of the selected texts has been begun. Chapman's Hero and Leander, a much neglected poem, has been interpreted as a vehicle of his love philosophy. Difficult and obscure passages have been explained, and the whole meaning of the poem has been brought out with what is hoped to be new clarity and accuracy. The details of Hero's psychological development have been thoroughly examined. The Tale of Teras has been explained as the key to Chapman's poem since it contains the ideal wooing of Eucharis with which the affair between Hero and Leander is meant to be contrasted. Similarity between ideas in Chapman's poem and in Ficino's Commentary has been noted. Chapman's allegiance to the idealistic, Neoplatonic attitude toward love has been contrasted with the naturalistic and anti-Neoplatonic approach to love which Marlowe makes in the first two sestyads.

Ennis Rees's view that Bussy is a cautionary and not an exemplary character, that he is a passionate, lawless man who destroys himself and not the representative of admirable VIRTU that traditional criticism has made him, appeared in Rees's book The Tragedies of George Chapman (1957). This interpretation of Bussy has seemed eminently correct to me. The Bussy-Tamyra affair has been discussed in the light of it, and it has been shown that the affair is a "court-love," a vulgar and wanton love which violates all of the tenets of Chapman's philosophy of love.

Two love relationships which appear in The Revenge of Bussy D'Ambois have been considered. The friendship between Clermont D'Ambois and the Duke of Guise has been explained as the best example in Chapman of a true, Ficinian Platonic love. The problem of what has traditionally been considered the strange alteration in the character of the Duke of Guise between his appearances in Bussy D'Ambois and his reappearance in The Revenge of Bussy D'Ambois has been approached through the Neoplatonic love philosophy of Chapman, and it has been argued that the Guise in Bussy D'Ambois is a good character and therefore a natural candidate for the friend of Clermont. Clermont's liaison with the Countess of Cambrai has been shown to be a rather wanton love, and an attempt has been made to understand why the otherwise virtuous Clermont has become involved in a love affair of which Chapman could not have approved.

Microfilm $2.50; Xerox $8.60. 187 pages.

VISION AND THE ROLE OF THE PAST IN THE NOVELS OF GEORGE ELIOT

(L. C. Card No. Mic 59-5458)

Naomi June Diamond, Ph.D.
University of Washington, 1959

Chairman: Arnold Stein

This study proposes that clear vision, as George Eliot conceived it and experienced it, presents a significant key to structure and theme in her novels, and an important insight into her own artistic mode. A vision, the product of imagination and feeling, is an intensely felt view of the lives of others or oneself. The measure of its truth depends on the degree of imaginative sympathy in the beholder, a degree that suffering, if nothing else, may extend. It is this conviction that determines one basic structural line in George Eliot's novels: the progress of her characters through illusion and painful disenchantment to a clearer vision of reality. (I think of one exception only--Tito Melema, whose retreat into blind egoism--the antithesis of clear vision--is halted only be death.)

A moral artist, George Eliot is profoundly committed to teaching her reader "the art of vision." This intention largely determines her choice of themes, treatment of characters, and artistic techniques. It directs, too, her concern with the past and her emphasis on the commonplace for the substance of her stories. Fundamental to her concept of clear vision is a consciousness of the continuum, of the past as a living part of the present and the future as the outcome of both. For in the personal past are formed the ties to which one must adhere if he is to lead a moral life; in that past too, if anywhere, are lodged the affections which provide the strength to adhere to those ties. To sound the regions of the reader's early past, which are not recoverable by "voluntary memory," George Eliot presents objects, characters, scenes that will set up "involuntary" associations in the mind of the reader. It is for this that she relies on the commonplace, the typical and the archetypal.

Finally, her moral purpose dictates that she employ the art of vision in the development of her stories; that is, by dwelling on her characters with imaginative sympathy, she visualizes the course of their lives. The result is rarely artificial, because vision was the spontaneous part of her creative mode.

This study considered closely Adam Bede, The Mill on the Floss, Silas Marner and Middlemarch. The concluding chapter showed the persistence of similar themes and structural patterns in the three remaining novels. Adam Bede was treated as an example in the art of vision. The Mill on the Floss dealt with the role of the past--personal, public and cultural--as a guide to clear vision. In Silas Marner the isolated state of the miser was defined primarily in terms of his rejection of the past. The child Eppie restored him to memory and the community. Middlemarch, a masterpiece of construction, revolved about this central dilemma: on the one hand, the obligation of one who seeks the fully moral life to find it through a deep commitment to humanity; on the other, the difficulties that pursue him, by nature imperfect and corruptible, in a society which is dominantly corrupt. All the various stories serve essentially to illustrate this theme.

Everywhere the concept of vision determined major

structural and thematic lines, but auxiliary themes too received substantial development. When this occurred, I pursued what tangential lines seemed to be illuminating. That is, I did not approach the novels solely to illustrate George Eliot's theory of vision. What I hope I have achieved, rather, is a flexible partnership by which the theory and the novels may illuminate each other.

Microfilm $5.60; Xerox $19.60. 440 pages.

PORTRAIT OF THE POLITICIAN IN THE AMERICAN NOVEL: 1870-1910.

(L. C. Card No. Mic 59-6704)

Wilfred Anderson Ferrell, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Philip Graham

Because of his distinctive role in society, the politician has been a significant figure in the portrayal of the American scene. This dissertation is a study of the political types cast as principal characters in the novels from 1870 to 1910, an important period in the course of American literature. Seventy-seven characterizations from sixty-one novels provide the evidence for an evaluation of the fictional politician in the development of the American novel.

In their delineation of the politician, novelists of the period 1870 to 1910 relied on seven stereotyped figures: (1) the rising young man, (2) the rising young man who falls, (3) the aristocrat politician, (4) the capitalist politician, (5) the satirically ridiculous politician, (6) the dishonest professional politician, and (7) the leader of the people.

The first of these is a highly virtuous person of modest circumstances whose determination and exceptional abilities carry him to political success against dishonest opponents who employ every means at their disposal to thwart him. The rising young man who falls has the promise of a brilliant career, but he also has a weakness that leads to his downfall. His flaw may be inordinate ambition, lack of will power and courage, love of money, or some other tragic defect.

The aristocrat politician possesses the virtue, courage, and pluck attributed to the rising young politician and, in addition, is wealthy and cultured. Ridiculed by his family and friends for participating in what they consider a degrading activity, he believes, in most instances, that as a man of education and principle he is obligated to serve in public affairs.

Both the capitalist and the dishonest professional politicians are disreputable figures who use hypocrisy, intrigue, and criminal actions to gain power and wealth. Invariably they meet defeat and frequently death. The satirically ridiculous politician is a naive, fatuous figure who is easily exploited by flattery.

Novelists portrayed the honest professional politician as a figure who overcomes financial and social handicaps and rises to political leadership. Although years of experience have made him an astute, practical politician, he remains a man of the highest principles. His success as a leader lies in his magnetic power to attract the confidence and admiration of the people.

Authors in the period 1870 to 1910 who portrayed the politician observed the literary and social conventions followed in the novel of the time. On the one hand, their delineation of the politician as a heroic figure who dramatically overcomes great obstacles and attains social and political prominence followed the conventions of romanticism and sentimentalism and represented a version of the American success story. Most of these characterizations are journalistic and mediocre, but a number, such as Twain and Warner's Senator Dilworthy (The Gilded Age), DeForest's John Vane (Honest John Vane), Boyesen's Horace Larkin (The Mammon of Unrighteousness), Whitlock's Jerome Garwood (The Thirteenth District), and Ellen Glasgow's Nickolas Burr (The Voice of the People), represent notable literary merit.

On the other hand, when novelists portrayed the politician in order to examine and criticize the evils of politics, they followed the conventions of social criticism. The figures they drew and the situations they described reflected the political corruption that stains the history of the period. Herein lies the greater significance of the politician in the novel, for in using him novelists adopted the modes of realism. They rejected much of the traditional romanticism and sentimentalism and attempted to portray life as it actually was. Microfilm $2.50; Xerox $8.60. 186 pages.

IMAGERY IN ROSETTI'S HOUSE OF LIFE

(L. C. Card No. Mic 59-5641)

Robert DeSales Johnston, Ph.D.
University of Missouri, 1959

Supervisor: Charles M. Hudson

The only study to consider Dante Gabriel Rossetti's The House of Life in and for itself is Paull F. Baum's (1928). At the turn of the century there were many Rossetti biographies and some articles that commented on his work. Lately there has been renewal of interest, but most of this research, past and present, has been biographical in approach. Only a few articles, scattered along the way, have mentioned imagery.

Many unilluminated places remain in Rossetti research. A study of the imagery in The House of Life helps throw some light across some of these dark areas, for it affords yet another approach to the poet's complex and highly sensitive being.

For Dante Rossetti the topics of love and of death and personal disillusionment are primary. His failure to achieve happy love and fruitful accomplishment plague him, and these hopes and despairs find voice in the sequence. The important question here is, What is the language he chooses to set down this vacillating record of ecstasy and unhappiness? There are specific images which he selects to illustrate his ideas, and when these images recur constantly in similar context, they may be evaluated and interpreted with assurance.

Some of his images are quite common to poetic expression, like light in the writings of mystics, and other images

are distinctly Rossetti's own, like his concept of the birth of Love as an issuance from deep, dark places, a birth expressed in a sexually connotative language of the shredding and ripping aside of darkness.

Since the appearance of the completed House group in 1881, critics have debated the pros and cons concerning the unity of this sequence. Actually the sonnets do enjoy a unity, even though Part I treats Love and Part II turns to a consideration of the poet's ambitions. This unity is achieved through imagery, for both parts employ the same imagery to illuminate the ideas there.

Rossetti brooded over his poems and paintings as much as he did over his worries, and as a result most of his sonnets have undergone extensive revision. In some instances this has proved to be beneficial, and in others the changes, introduced over the years, have impaired earlier beauty. The outgrowth has been that many hoped-for signs of stylistic growth have been eradicated. Early sonnets, and most sonnets have been accurately dated by William Rossetti in his 1911 edition of his brother's work, show features of late style, and late poems reflect earlier characteristics. Even so, some things can be concluded concerning his style, but these are largely general in nature. For example, his later poems tend to indicate a preference for polysyllabic language and complex syntax, often at the expense of clarity. As for such mechanical tests as run-on lines, personifications, alliteration, hyphenation, and the like, these traits are observable in poems of all periods.

Rossetti looked to love and personal accomplishment for happiness, and he failed at both. But his desire to succeed always equalled his realization that neither would come to him. Therefore, his eyes turn inward and he writes with poignancy. As a poet he deserves a place among the best of English sonneteers for the profound insights he has brought to bear on a limited range of ideas, but because these ideas are so limited in number, and because his voice so often remains so individually his own, Rossetti lacks the breadth that lifts a poet from the rank of a great craftsman to a place among the literary giants.

Microfilm $2.90; Xerox $10.00. 224 pages.

A HANDBOOK TO WORDSWORTH'S SONNETS

(L. C. Card No. Mic 59-6719)

Ronald Weldon McReynolds, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Willis W. Pratt

Wordsworth's career as a poet has been studied by many scholars and critics, but seldom has attention been drawn specifically to his importance in establishing the position of the sonnet form in English literature. A small handful of his sonnets has received attention along with his other poetry, but for the most part the majority of his nearly five hundred sonnets have slipped into obscurity. The difficulty in conveniently securing pertinent information concerning these sonnets causes the writer to feel the need for a handbook to Wordsworth's sonnets.

This study is organized into eight chapters, and an index of the titles and first lines of the sonnets. The initial chapter establishes Wordsworth's reputation as a sonnet writer by discussing some of his widely published sonnets and by bringing together critical estimates ranging from his own time down to the present. Each of the remaining seven chapters of this study centers on important sonnet collections or on groups of miscellaneous sonnets Wordsworth published. Insofar as possible each group is discussed in the order of the poet's composition.

In these chapters each sonnet Wordsworth wrote is dealt with following a systematic outline. The date of the sonnet's first publication and where it originally appeared are given. The text of the poem is summarized and pertinent information concerning its genesis and composition is given. Sources from which Wordsworth drew his material and any influences that are discernible from other writers, Wordsworth's own poetry, or from his own knowledge and acquaintances are pointed out. Finally, criticism of the sonnet is listed, usually the criticism contemporary to the publication of the sonnet appearing first, followed by more recent criticisms.

This volume is intended as a reference work to be used in studying Wordsworth's individual sonnets as well as placing him in his deserved position in the history of sonnet writing. Microfilm $6.30; Xerox $21.80. 495 pages.

THE INFLUENCE OF VILLIERS DE L'ISLE-ADAM ON W. B. YEATS

(L. C. Card No. Mic 59-5471)

Lloyd Clifford Parks, Ph.D.
University of Washington, 1959

Chairman: Frank W. Jones

Yeats's critics generally minimize the importance of French influences in his work, yet it seems likely that no writer affected it more profoundly than Villiers de l'Isle-Adam. Villiers' influence operates throughout the corpus of Yeats's writing and is eventually complicated by ideas and techniques traceable to Maeterlinck and to Mallarmé, both disciples of Villiers.

Yeats's acquaintance with Villiers' work likely included Tribulat Bonhomet and the Contes Cruels. But it is certain that he read La Révolte and Axel. And Axel is the one work we can be certain Yeats read in French. It impressed him deeply. A year after he read it, he saw the play performed and wrote an enthusiastic review. In 1925, in a preface to a translation of Axel, he says: "-- I but discover there is no escape, I am still dominated." And six years before his death he writes: "Perhaps Faust, Louis Lambert, Seraphita and Axel are our sacred books." As a young man, he would inscribe books with Villiers' phrase: "As for living, our servants will do that for us." The same phrase recurs some twenty times in Yeats's own work.

There is evidence in Yeats's poetry, plays and prose that Villiers exerted a constant influence over him. But that influence is most apparent in the writing he did between 1893 and 1900. In The Wind Among the Reeds (1899), in The Secret Rose (1897), and in The Shadowy Waters (1900), we find that a single theme dominates, and it is essentially the theme of Axel: l'Infini seul n'est past un mensonge. This theme is developed in Yeats's work as it is in Villiers' by means of a tension between two

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philosophies, one materialist, the other idealist. Also, we find the same obsession with hair in both authors' work, and the evolution of Yeats's rose imagery suggests that Villiers encouraged him to develop the Rosicrucian symbol However, the most overt example of Villiers' influence is to be seen in The Shadowy Waters. It is the last act of Axel staged on the high seas. Yeats was, in fact, not able to finish his play until he borrowed from the denouement of Axel.

In The Secret Rose and in "Rosa Alchemica", "The Tables of the Law", and in "The Adoration of the Magi", we see the development of Yeats's magus figure. The figure stems from Yeats's Rosicrucian initiation, and one of the models for it was Janus, the wizard of Axel, "the prototype of the Rosicrucian adept." "The Tables of the Law" shows Yeats advancing a doctrine of "art for art's sake", a strong influence of Mallarmé, and an interest in Byzantium. In "Sailing to Byzantium", Yeats's mysticism and esthetic fuse.

A reaction sets in eventually, and "The Stories of Michael Robartes and his Friends", though long after the fact, express it. These tales tell us that Yeats is done with the erotic idealism of Axel and with Villiers' brand of idealist quietism. Yeats announces that the resolution of conflict is to be found in conflict, not in death, which is Villiers' solution.

Nevertheless, Villiers' influence continues to operate in the late poetry. In the tower poems, Yeats's attitude, an attitude Arthur Symons, with reference to Villiers, has called "the aristocratic conception of things", suggests a continuing reliance on the French author's work. "Sailing to Byzantium" represents a fusion of Yeats's esthetic (largely shaped by Mallarmé) and of his occult idealism, for which he is deeply indebted to Villiers de l'Isle-Adam.

Microfilm $2.85; Xerox $9.80. 220 pages.

POLITICAL-HISTORICAL BEARINGS IN ORIGINAL INTERREGNUM DRAMA FROM 1649-1660

(L. C. Card No. Mic 59-5649)

Mary-Joe Purcell, Ph.D.
University of Missouri, 1959

Supervisor: Donald B. Clark

The original drama of the years 1649-1660 is filled with political and historical references, expressed either forthrightly or obliquely, and was used by Royalist dramatists for news reporting, slander, and propaganda. Dramatically, most of the plays are almost worthless. There was evidently little concern for production; the plays were written primarily to be read and because the Puritans brought arguments against them in their newspaper, the Mercurius Politicus, and continued to oppose drama throughout the period, it may be believed that they were read. By juxtaposing history and the drama it is easily seen that these years of great historical intensity were reflected in the dramatic form, and, in turn, were directed somewhat by the dramatic form.

From 1649 to 1651 open attacks were made against particular Puritans in such anonymous plays as New Bull Baiting, New Market Fair, and The Famous Tragedy of King Charles I. When the Protectorate was formed and the civil wars were ended, however, the dramatists naturally feared for their lives and their attacks against the Puritan government and Puritan leaders became indirect. During this time the heroic drama seems to have made a very definite entry through such plays as Love and War, The Enchanted Lovers, The Unhappy Fair Irene, and The Wandering Lover. The heroic dramatic characteristics of ranting, spectacle, and love of a man for a woman of an opposing party can be seen in at least a dozen plays written during the 1650's. It was in 1656 that Davenant produced The Siege of Rhodes, I, which was thought by the heroic dramatists of the 1660's to be the first heroic play. These plays served the Royalist dramatists of the 1650's in two ways: they aided in making the drama a little more exciting and they afforded an opportunity for speaking of the two-sided political situation in England quite indirectly; both interests can be seen in a play of 1652 by Manuche called The Loyal Lovers, which concerns a Royalist ex-officer and the daughter of a "committee-man."

It was not until 1657 that another direct attack against the Puritans appeared and this was in a play entitled Fancy's Festivals. Despite inroads made by Davanant, there still remained more printed than produced plays. Yet in 1658 drama had become important enough that Richard Cromwell, who was then Protector, had the theatre investigated. It was evident to a few at least that the Puritan regime was loosing its power. In 1659 Shuffling, Cutting, and Dealing, a play which directly names many Puritan leaders was printed, but it was not until the return of Charles II in 1660 that dramatists really began their asault in earnest. In 1660 direct attacks against the Puritans were made in Cromwell's Conspiracy and The Famous Tragedy of the Life and Death of Mrs. Rump. Drama had described a circle in time.

When the King was beheaded and it seemed that Charles II might take the throne quickly, the playwrights were forthright; when the truth was known that the Puritans had gained control, only indirect statements--often through the guise of a loyal man in a mythological or foreign country or in England in the distant past--were made; later, when it was believed that Charles II would return, the forthright attacks against the Puritans began again.

The drama of the period 1649-1660 shows clearly the effect that historical and political events had on it and by using the political and historical events as a basis for much of the drama, the dramatists maintained the form throught to be the delight of a defunct system.

Microfilm $2.90; Xerox $10.00. 224 pages.

THE CONCEPT OF REALISM IN THE NOVEL: A RE-EXAMINATION.

(L. C. Card No. Mic 59-5475)

Franz Karl Schneider, Ph.D.
University of Washington, 1959

Chairman: Frank W. Jones

This dissertation, The Concept of Realism in the Novel: A Re-examination, compares five novels: Flaubert's Madame Bovary, Tolstoy's Anna Karenina, Hardy's

Return of the Native, Fontane's Effi Briest, and Dreiser's Sister Carrie. The writer comes to the conclusion that realism is still a usable and meaningful literary concept, that a definite view of reality is associated with it, that this view depends on a corresponding set of narrative procedures, and that it is primarily the mode of treatment, and not the subject matter that constitutes realism.

Generally speaking, realism is not confined to one particular period of man's history. It teaches that, independent of man's consciousness, a basis for existence and the world is given. The modern realist interprets this in a common sense manner: There is a real objective world to be known, a mind capable of knowing, and a sense perception that connects the objective world with the knowing mind. Thus, realism, by being mainly concerned with observable fact susceptible of scientific description and exploration, rejects universals.

Since for the realist the pursuit of truth is conceived of as a wholly individual manner, important changes resulted in the use of narrative procedures in the novel. The first change is the rejection of the traditional plot. The new plot deals with life as being and it reflects a belief in the individual apprehension of reality through the senses. The primacy of individual experience also results in a sharper differentiation of personages and the greater individuation of characters. This is the direct result of the realist's conviction that material phenomena are valid and that the behavior of human beings can be objectively presented.

The tendency toward particularity in the literature of realism, then, can be concretely demonstrated by two specific aspects of fictional technique--characterization and presentation of background. It also explains the realist's concern with personal identity and time. Time is not only an extension of the physical world, but it becomes the shaping force of man's individual and collective history. Hence what Ian Watt says about Defoe, in The Rise of the Novel, applies also to the five novels under consideration: "His fiction presents us with a picture both of the individual life in its larger perspective as a historical process, and in its closer view which shows the process being acted out against the background of the most ephemeral thoughts and actions."

But there is evidence that the realists treated in this study are none too confident in their reliance on particulars which compels them to portray humanity, in Watt's words, as "a developing but unplanned aggregate of particular individuals having particular experiences at particular times and at particular places." The impulse to compensate for the lost universals is often quite strong. Flaubert's insistence on poetry, Tolstoy's ethical fervor, Hardy's philosophy turned into a literary idea, Fontane's paradoxical presentation of state and society, and even Dreiser's concept of man as a biological animal; all these try to express something that reaches beyond the particular.

Still, all five novels depend on the "formal realism" of the novel which, according to Ian Watt, consists of an authentic report of human experience and of the author's success in satisfying the reader "with such details of the story as the individuality of the actors concerned, the particulars of the times and places of their actions, details which are presented through a more largely referential use of language than is common in other literary forms." Microfilm $5.10; Xerox $17.00. 397 pages.

HERMAN MELVILLE: THE FORMS AND FORCES OF EVIL.

(L. C. Card No. Mic 59-6574)

Joseph Thomas Ward, Ph.D.
University of Notre Dame, 1959

This is a study which attempts to arrive at a deeper understanding and fuller appreciation of the works of Herman Melville by examining the literary devices that he employed to project and dramatize his concept of evil. In this investigation particular attention was directed toward Melville's use of the occult, especially of diabolistic materials, in presenting his dark view of evil in the world, in man himself and in the nature of all created things.

The study began with an investigation of those diverse forces which from boyhood to early manhood might have aided in directing and sensitizing Melville's mind and attitudes toward the more sinister side of man and nature. The religious training that Melville received as a youth was examined in an attempt to determine the extent of his indoctrination in the tenets of the Dutch Reformed Calvinism and the kind of religious discipline and doctrine he might have received at home. Melville's reading background was also scrutinized, especially in the area of the poetical, religious and philosophical treatment of evil: his early reading of Milton and of the ancient pagan and Eastern philosophers, such as Plutarch, Plato and the Persian Magians, his later reading of Burton, Bayle, the Romantic poets and Hawthorne.

In the course of this investigation all the major fiction of Melville was examined, from Typee to Billy Budd, with special acknowledgement made of Melville's subtle exploitation of allusions to the ancient heresies, of his use of recurrent images of darkness, lurid fires and serpents, and, above all, of his utilization of the many and varied elements of diabolism throughout his writings. A special effort was made to relate Melville's handling of such devices to their employment in the sources that he used, such as Bayle who may have revealed to him the real connection existing between the mysterious practices of African and Eastern sects and the obscene and abominable rites of Satan worship, and Hawthorne who opened up to him the whole background and tradition of New England witchcraft.

This study revealed that in nearly all of his major stories Melville utilized, to some extent, the artistic expression of diabolism to represent in dramatic form the full impact of those Evil forces which he conceived as constantly at war and apparently triumphant against the influence of Goodness. An analysis of the diabolism present in Melville's work made clear the deep significance and the profound unity existing among the many obscure allusions made to cannibalism, savage sorcery, fire worship, and the ambiguous references made to Cainite, Ophite and Zoroastrian doctrines. Such a reading disclosed that a basic interpretation of many of Melville's works might be aided and enlarged by a more detailed examination of elements which may be said to lend to the diabolical atmosphere of his stories. Many passages which appear at first reading innocent enough become charged with sinister undertones and finally clothed with a more profound significance when they are cast into their proper relationship with other more clearly ominous portions of the stories.

Thus, this study concluded that such an approach to the

work of Melville could aid the critic in obtaining a clearer perspective of Melville's work and the relationships among its various parts and that a careful investigation of the forms and forces of evil, especially those that pertain to diabolism would enable the critical reader to understand Melville better.

Microfilm $4.30; Xerox $14.40. 333 pages.

GEORGE CHAPMAN'S COMEDIES: THE USES OF INTRIGUE.

(L. C. Card No. Mic 59-5841)

Henry Matthew Weidner, Ph.D.
The University of Wisconsin, 1959

Supervisors: Professor Madeleine Doran and Professor Mark Eccles

The normal approach to Chapman's comic art which sees it as convention-ridden at worst or as a prior hint of Fletcher and company at best is flatly rejected in this study. In proving my case that Chapman is a significant comic dramatist who ranks close behind Shakespeare and Jonson in general merit, I also attempt to employ the conclusions drawn from the study to shed further light on the difficulties of Chapman's tragedies. For several reasons it would appear that the factors which helped make Chapman a very fine comic writer made him unfit for the tragic genre.

The chief merit of the comedies is the ability of the artist to vivify and sometimes transcend by means of varying kinds of complex irony set in an intrigue plot the conventional devices, concepts and comic modes of the age. In Chapman's comic world, and increasingly so in the last three highly controlled ironic comedies, The Gentleman Usher, Monsieur D'Olive, and The Widow's Tears, the main target for criticism is the naive absolutist, the man who feels he is an heroic figure capable of special learning, or vows, or loves. The last comedies provide a masterful analysis of modern failures cast against the image of Homeric idealism which pervades all Chapman's work.

For Chapman the device of intrigue is crucial. It is based on his understanding of the theatrical traditions, the general atmosphere of his age, and on the image of Ulysses, the Protean intriguer, the man of heroic action who also negotiates with his society by subtle devices. In Homer's world, itself an approximation to the ideal Golden Age, essentially simple, if titanic figures are engaged in conflict with essentially simple, if monstrously challenging environments. The struggle is grand but its outlines are clear; not so in the more complex Renaissance society. The way modern intrigue is employed is often the fit subject of comedy. Those who fail to have keen insight into the true value of a Golden Age, or decorum, or who have dulled, modern responses to the heroic image, these are the fools who are both the subjects and the organizers of modern intrigue. A few wise souls still exist, the intriguers of great complexity like Margaret in The Gentleman Usher or Vandome in Monsieur D'Olive who know how to manipulate delicately the masks they wear. A few heroic souls exist, most in the tragedies; but none except Strozza, the hero of The Gentleman Usher, a "miracle play" much on the order of Shakespeare's last romances, exhibits complex wisdom. None have the ability properly to employ intrigue. In the tragedies, intrigue is reduced to evil "policy." The heroes are left only with naive simplicity as their major trait in facing an increasingly vicious world; as the ideal of a golden state fades in Jacobean England, Chapman tends in his tragic drama to cling more tenaciously to it. In Chapman the shift to "Jacobean pessimism" from "Elizabethan wonder" brings the florescence of his comedies and the birth of his stultified tragedies.

The fun in Chapman's comedies lies in the dramatic interactions of "type" characters, interactions which are a reminder of man's true complexity. Man is simple in Restoration, Roman, and Italian comedy; his "typing" is a limiting process. Man is complex in the best of Chapmar as in the best of all Renaissance drama; his "typing" is an infinitely suggestive process. No formula fits the concept of man derived from Chapman's comedies; unfortunately, too often formulae do describe adequately Chapman's tragedies. Microfilm $4.45; Xerox $15.00. 348 pages.

LANGUAGE AND LITERATURE, CLASSICAL

THE AGRICOLA MANUSCRIPTS OF PLINY'S LETTERS

(L. C. Card No. Mic 59-6432)

Richard McIlwaine Frazer, Jr., Ph.D.
The University of North Carolina, 1959

Supervisor: B. L. Ullman

The chief purposes of this work were to determine (1) the importance to the text of two manuscripts of Pliny's Letters and (2) whether either or both of these manuscripts were used in a later edition and a later group of corrections.

The two manuscripts are Stuttgardiensis, cod. poet. philol. $4^{o}30$, chart. a. 1478, lib. I-VII, IX (to which the sign R is given) and Leidensis, Voss. lat. $4^{o}80$, chart. a. 1478, lib. I-VII, IX (to which the sign A is given). Both of them were copied in Ferrara in 1478 and belong to the eight-book family in the tradition of the Pliny text.

The manuscripts R and A are collated with the Schuster text (1958) and the variants are compared with readings of the other manuscripts and editions listed by Schuster and Merrill (1922). The many places where R and A agree in disagreeing with all other manuscripts render it highly probable that they were copied from the same exemplar. Because they contain a great number of errors which were not in the archetype of the eight-book family, these manuscripts are of very little importance for the text of Pliny's Letters.

By external evidence and the identification of scripts it was determined that A was copied by Rudolph Agricola and that R, although not copied by Agricola, contains his corrections. A brief biography of Agricola is given, and the probable course of R from Ferrara to Stuttgart and of A from Ferrara to Leiden is reconstructed.

In 1530 Johannes Sichardus produced an edition of Pliny's Letters with the help of a manuscript of Rudolph Agricola. By collating his edition with the Schuster text and comparing the variants with the readings of R and A it was determined that the Agricola manuscript which Sichardus used was A.

In 1584 Franciscus Modius published a collection of his letters entitled Novantiquae Lectiones, in which he tried to improve forty passages in Pliny with the help of two Agricola manuscripts. That these two manuscripts were R and A is proved by the fact that his readings usually agree with them against the readings of all other manuscripts. Microfilm $2.50; Xerox $8.00. 172 pages.

COMMENTARY ON THE VITA PAULI OF ST. JEROME

(L. C. Card No. Mic 59-5358)

Rev. Philip Charles Hoelle, S.M., Ph.D.
The Ohio State University, 1953

The Vita Pauli is the life of St. Paul the First Hermit, written by St. Jerome about the year 376 A.D., when he was twenty-nine years old and was living an ascetical life as a hermit in the Syrian desert of Chalcis.

St. Jerome was born in 347, at Stridon, near the foothills of the Julian Alps in the finger-like northeastern tip of Italy between Pannonia and Dalmatia. He received the best education that Rome could offer, steeping himself in the classics under his teacher, the famous Donatus. After a year of travel in Gaul he decided to become a hermit and after a few years in Aquileia near his native Stridon, he suddenly left for Jerusalem with a band of pilgrims; due to illness he remained at Antioch with his friend Evagrius, who translated the Vita Antonii of St. Athanasius into Latin. In Treves St. Jerome had heard of this great hermit, St. Anthony, and it seems the example of his heroism played a large part in his determination to become a hermit himself.

After a few years in the desert, where he had begun his study of Hebrew, he returned to Antioch and there continued his studies. Soon he was in Constantinople as a pupil of St. Gregory Nazianzen in Scriptural studies. In 382 he became secretary to Pope Damasus in Rome; there his crusade for asceticism among high-born ladies and his sharp pen made him unpopular, and he left Rome in 385 for the East, and after visiting Egypt and Palestine he settled in Bethlehem for the rest of his life. In this cradle of Christianity he wrote his Scriptural commentaries, controversial treatises and the monumental Vulgate version of the Bible. The more polished of his letters reveal the master stylist and the scholarly rhetorician. In this commentary his letters are constantly referred to for stylistic comparisons. The greatest scholar among the Church Fathers died in his cell at Bethlehem, September 30, 419.

St. Jerome insisted on the historical personality of his hero, St. Paul, and in his own lifetime he had to defend his stand against sceptics. This doubt was reëchoed by the Magdeburg Centuriators and Erasmus, and in the late nineteenth century by Weingarten, who held that St. Paul never existed and that the Vita Pauli was just a rhetorical exercise. Weingarten had to discredit the existence of Paul in order to uphold his theory that Christian monachism arose in the second half of the fourth century, a century later than the traditionally accepted date of origin. Preuschen and Butler showed the weakness in Weingarten's arguments and today it is the common view of scholars that the Vita Pauli deals with an historical person in a legendary framework.

It was natural for the young hermit in the Chalcis desert to write about the origin of the hermits. History and rhetoric interested him in particular and these stories of the early hermit, St. Paul, provided fitting material for a charming biography in which he could eulogize the ascetic life in the person of this legendary hero. There is a place for fancy and imagination in every great endeavor, and St. Jerome indeed gives us a sound historical background while also freely mixing fancy with fact and blending rhetoric and poetry and mythology with proofs from personal experience and dramatic pleas to influence his readers toward the rigorous life of the hermit.

In writing the Vita Pauli St. Jerome made use of oral accounts from Egyptian bishops and monks exiled to Syria. He appealed to the first-hand authority of Aged St. Anthony's two disciples, Macarius and Amathas. To support one statement he evoked the written Egyptian records. Kugener shows that Evagrius' Latin version of the Vita Antonii was closely followed in certain passages and phrases and this is noted in the commentary. In the early seventeenth century Rosweyd when editing the Vita Pauli in Migne' Patrologia Latina mentioned that St. Jerome's Latin was the original text. In the late nineteenth century Amelineau declared that the original text was in Coptic. Nau considered Greek version b as the source of the Latin text. Bidez established the originality of the Latin by showing that Greek version a was a literal translation from the Latin text and that Greek version b was an abridged form of version a.

The Vita Pauli initiated a new type of hagiographical literature quite different from the Acts of the early martyrs. This largely legendary and imaginative account of the saintly hero's life continued in vogue through the Medieval period, culminated in Jacopo de Voragine's Golden Legend, and foreshadowed the modern novel. The immense popularity of the Vita Pauli is indicated by the more than five hundred extant Latin manuscripts and the more than hundred Greek manuscripts, besides Coptic, Syriac, Arabic, and Armenian versions.

The most important manuscript of the Vita Pauli is Latin ms. 106 of the K. family. Written in 517 A.D. in semi-uncials approaching the minuscule and averaging 24 letters to the line, it is the oldest dated Latin manuscript. It can still be seen in the Capitular Library in Verona. Its errors are minor and mostly orthographical. Other important manuscripts of the K family, which represents the tradition closest to the original text, are mss. 42 and 31. From the materials of W. A. Oldfather a critical text of the Vita Pauli, in which the twenty-five most valuable manuscripts are being used, is in the process of preparation by Kenneth M. Abbott and Leo M. Kaiser. It is to this unpublished text that this commentary is made. There are five important Greek versions extant: a, b, F, M, N. Version a, the source of the other four, was made very early, perhaps in the lifetime of St. Jerome and thus it ranks next to Latin ms. 106 in value in reconstructing the text.

There is a question whether St. Jerome brought out two editions of the Vita Pauli. Referring to it in one of his letters, he used the expression deiciendo sermone,

which may best be translated "by lowering the level of the style". Erasmus, finding so many variant readings, speculated whether St. Jerome did not write several accounts of St. Paul. St. Jerome's reference above seems to suggest a revised version which would reach a wider reading public.

Though he lived in a decadent period marked by dull imitation of ancient models and a search for oddities, St. Jerome's style is almost classical in structure. He has a personal and vibrant quality and a fancifulness with sudden popular touches and flashes of genius. His main defects are an excessive striving for erudition and rhetoric. So rapid is his style that he seems to improvise rather than compose. His genius was inspired by a brilliant imagination, a burning faith, and a lively literary taste. His thorough rhetorical training shows up in the Vita Pauli and in his early letters, especially at the beginnings where artifices and rhetorical effects abound. He excels in portraits; his account of the meeting between St. Paul and St. Anthony inspired Velasquez' masterpiece in the Prado.

The Latinity of St. Jerome reflects the changes caused by the impact of new customs, new ideas, and a new civilization introduced by Christianity. The vocabulary of Classical Latin is concrete and for this reason it is rich in verbal forms. Cicero succeeded in adapting the more abstract Greek ideas into Latin by his neologisms, especially in philosophy. Under Seneca the vocabulary became more and more abstract. In the post-Augustan age there was a breakdown in the distinction between prose and poetic vocabulary, and a consequent loosening and modernizing of the syntax.

St. Jerome coined technical words, like capabilis and deitas, and freely used Greek terms, like daemon and heremus, and hybrid words, like Christianus. Abstract nouns ending in -tio, -tas, and -ia, and agent nouns in -tor became common. St. Jerome liked the negative prefix in-, like intrepidus and insalutatus, to give force and decision to his style. Adjectives in -bilis, -alis, -ivus, new adverbs, and verbs from popular derivation find their way into his writings. From the popular element came words ending in -mentum or its poetic form -men, -monia, -monium, -arium, -orium, -culum, -aneum, -inium, -ura, -osus. Adjectives and present participles were not rare as substantives. St. Jerome readily borrowed from poetic language and syntax.

In general St. Jerome's syntax resembles the writers under the Empire. A freer syntax admitted poetic constructions and Greek terms but at the same time it was much stricter than the popular language, for he always remained a pupil of Donatus who introduced him into all the mysteries of language and style.

Not only did St. Jerome enlarge the domain of the Latin language by making it capable of rendering modern ideas and feelings but he also surpassed his contemporaries in the way in which he assimilated the esthetic culture of antiquity.

Prose rhythm entered into Latin through the Greek teachers in Rome in the first century B. C. It was developed by Cicero and continued its appeal to the cultured readers in Silver and Late Latin. St. Jerome used it in the more carefully written letters and in some of his rhetorical writings, including the Vita Pauli, but it appears under a quite complex form because at that very time the clausula based principally on the quantity of syllables was rapidly changing to a new form based on the arrangement to accented and unaccented syllables, without ceasing however to be quantitative. In this transitional stage St. Jerome probably followed his ear rather than fixed rules. Knook, in his study of Letters 1-18, which are contemporary with the Vita Pauli, found that the quantitative clausula - ∪ - - ⏑ had the highest frequency, and that 81.9 per cent of the uses of this favorite clausula show an interval of two unaccented syllables between the last two accented syllables, counting secondary accent. The discovery of the author's favorite clausulae at times enables the textual critic to reestablish the original text.

This commentary examines the vocabulary, syntax, and style of the Vita Pauli and devotes special attention to the sources that the author used or may have used in the text. Every significant word or phrase was probed to see whether it derived from Early, Classical, Silver, Late, Christian, or Popular Latin. This detailed study of sources revealed the direct borrowing from nearly all the leading Latin authors, both pagan and Christian: Plautus, Terence, Cicero, Caesar, Sallust, Vergil, Horace, Ovid, Livy, the two Senecas, Petronius, Pliny the Elder, Pliny the Younger, Quintilian, Tacitus, Apuleius, Tertullian, St. Cyprian, and the Vulgate from Genesis to the Apocalypse. In addition, every effort has been made to discuss the biographical, historical, and geographical, as well as the ascetical and mythological data needed to understand the text. Important manuscript variants are noted, and problems of textual criticism are fully discussed on the basis of the manuscript evidence, the usage of St. Jerome himself, and other Latin Authors. Microfilm $3.65; Xerox $12.40. 282 pages.

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A FIFTEENTH-CENTURY MANUSCRIPT OF PORPHYRIO'S COMMENTARY ON HORACE

(L. C. Card No. Mic 59-6436)

Elizabeth Hunter Jones, Ph.D.
The University of North Carolina, 1959

Supervisor: B. L. Ullman

Editors of Porphyrio's commentary on Horace have relied mainly upon the readings of two ninth-century manuscripts, V and M, which constitute the Lorsch tradition. There are also extant a number of later manuscripts written for the most part in the fifteenth century. According to A. Holder, the most recent editor of Porphyrio, all of these later manuscripts except Paris 7988 are descended from a manuscript brought back to Italy from Germany in 1455 by Enoch of Ascoli. This manuscript, which no longer exists, is considered to have been close to the Lorsch tradition. Its descendants, however, have been generally rejected as too interpolated to be of use in determining the text. The purpose of this dissertation is to test these assumptions by collating one of these later manuscripts, C=Vatican, Chisianus Lat. H. VII. 229, with Holder's edition and comparing its readings with those of three other late manuscripts, Q=Paris 7987, W=Wolfenbüttel Gud. Lat. no. 85, and R=Vatican, Ottob. Lat. 1434.

C was chosen for this study because its external history indicated that it was very close to the manuscript discovered by Enoch. It was written in 1460 for Pope Pius II, who had been trying to obtain Enoch's manuscripts after the latter s death in 1457 and actually got a copy of his Tacitus manuscript early in 1458. In view of this connection, it is evident that Pius also had a copy of the Porphyrio made at the same time or shortly afterwards.

The comparison of the readings of C with those of Q, R, and W revealed that the four manuscripts fall into two groups: CQ and RW. The archetypes of these groups, α and β, were copied from a common exemplar, which was identified on the basis of the external evidence as the copy of Enoch s manuscript made by Pius II.

R and W are further removed from the archetype than C and Q. Q is an incomplete manuscript and seems to have been copied from α somewhat later than C. Therefore C is the most faithful representative of the Enoch tradition, and as such its readings should be considered in any further study of the history and relationship of the manuscripts of Porphyrio.

Microfilm $2.50; Xerox $8.60. 187 pages.

AN ANALYSIS OF THE ALLEGORICAL INTERPRETATIONS IN THE SERVIAN COMMENTARY ON THE AENEID

(L. C. Card No. Mic 59-6437)

Julian Ward Jones, Jr., Ph.D.
The University of North Carolina, 1959

Supervisor: B. L. Ullman

The purpose of this study was to determine the nature and extent of the allegorical notes contained in the greatest surviving ancient commentary on the Aeneid, that of the fourth-century grammarian Servius. All of those interpretations which might be termed allegorical were collected and classified by groups. The commentary was found to contain examples of all the traditional forms of allegorical interpretation evolved by the Greeks and Romans (i.e., historical, moral, physical, and euhemeristic) and in addition a number of allegorical explanations representing a new development which I have designated allegorism ex ritu Romano. One allegorical note, while not admitting of classification, was seen to be a definite link with the later interpretations of the Middle Ages and Renaissance.

Although the notes collected were not really numerous considering the length of the commentary, they appeared to comprise a very important part of the exegesis. The allegorical interpretations ex ritu Romano on Aeneid iv and the allegorical interpretations of the moral type on Aeneid vi clearly constitute leitmotifs for the explanation of these entire books.

It was concluded that the allegorical explanations presented by the Servian commentary are generally unoriginal. Those of the physical type go back to Stoic sources, perhaps principally to Varro's Libri divinarum rerum. The euhemeristic explanations derive from a number of Greek and Latin authors, some of whom Servius mentions directly. The examples of allegorism ex ritu Romano probably depend ultimately for the religious information they contain on the work of Varro just mentioned.

The original or personal element discovered in the notes studied was the attitude or viewpoint which they, considered together, reveal. The commentator was seen to be a person of strong philosophic inclinations. He was obviously a person of extreme sophistication and in his approach to ancient mythology could be rational to the point of coldness.

Servian allegorical interpretations usually were found to be imposed upon Vergil rather than suggested by or derived from him. Some comments, however, proved to have a certain amount of aptness. Interpretations of the historical type, especially those concerning Augustus and the Caesarean family, are frequently plausible and might have been elaborated even further. Some of the cases of allegorical explanation on the physical principle approach closely the physica ratio of Vergil even though they do not exactly coincide with it.

Most of the examples of allegorism ex ritu Romano come, not from Servius proper, but from the pseudo-Servian Scholia of Daniel (included in the edition of the commentary used for this analysis and believed by many scholars to be excerpts from the lost Vergil commentary of Aelius Donatus). This situation is explained as resulting from the fact that such comments display a curious interest in traditional religion which is foreign to the nature of the commentator and does not reflect the religious climate of his time. No previous study has served to distinguish so sharply the difference in degree of religious interest that exists between the real and the false Servius.

Microfilm $2.55; Xerox $8.80. 195 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

FLORIDA PLACE-NAMES

(L. C. Card No. Mic 59-6090)

Bertha Ernestine Bloodworth, Ph.D.
The University of Florida, 1959

The names of some 2,400 places in Florida are viewed from the standpoint of their origins, meanings, modifications, and connotations to see what they reveal about Florida and its people. The names--a sample which includes the names of all major political subdivisions and natural features of the state and of many minor places--are classified as commemorative, descriptive, or cultural. When examined, they review the long history of the state; describe its climate, topography, vegetation, and wildlife; and reveal many cultural characteristics of its people.

The commemorative place-names memorialize men from Columbus and Ponce de León to twentieth-century Florida governors; proclaim the loyalties of Floridians and the sides they took in wars; recall the Spanish, the French, and the American periods; tell of the Seminole Wars, of early statehood, of Florida's part in the Civil War, of late-nineteenth- and early-twentieth-century millionaire developers, and of plain settlers; and perpetuate

the memory of Indians who played a part in the Florida story. These names also keep alive the memory of significant events in the history of the people, their ideas and ideals, and the places from which they came, thus emphasizing further the cosmopolitan character of Florida's settlement history.

The descriptive names detail the natural characteristics of Florida--its vegetation, its wildlife, its climate, and its topography. Many of them indicate, by force of numbers and by metaphorical quality, the salient characteristics of the state which its residents value most and which have been most important in its economy.

The cultural names augment the history told and the picture painted by the commemorative and descriptive names and reveal humor, religious backgrounds, literary tastes, occupations, attitudes, romance, and folklore.

All the names together reveal Florida and its people, and in a larger sense they illustrate many of the fascinating processes and vagaries of place-naming in general.

Microfilm $3.40; Xerox $11.60. 264 pages.

NEVADA PLACE NAMES: ORIGIN AND MEANING.

(L. C. Card No. Mic 59-6170)

Helen Swisher Carlson, Ph.D.
The University of New Mexico, 1959

The purpose of this dissertation is to identify and locate a place and, insofar as is possible, to tell when, why, and by whom a place was named and to relate it to the land, history, and people of Nevada. The names include all existing post offices, counties, railway stations, and national forests, cities, towns, and settlements, and the best known lakes, creeks, mountain ranges and peaks, canyons and washes. Mail stations, ranches, mines, and forts of historical importance have been included.

Origins of place names in Navada may be traced by means of the settlement pattern of the state. The name-givers, who have been identified whenever possible in an effort to discover something of the name process, have been grouped as follows: Amerindians, fur trappers and explorers, immigrant parties and religious groups, prospectors and investors, ranchers and town builders, railroad builders, government surveyors and agencies.

The names are classified in accordance with the categories established by George R. Stewart, supplemented by the Animal Possessive and the Folk Imagination, Affection, and Humor classifications suggested by Thomas Matthews Pearce. The classes are (1) descriptive names that originate from some permanent or semi-permanent quality of a place, with false, pure, negative, associative, and relative sub-classes; (2) possessive names, usually marked by the use of the possessive case, that have been applied because of the feeling that some person, persons, or animals owned it, with personal, animal, ethnic, and mythological sub-classes; (3) incident names that identify a place by means of some incident which has occurred at or near it, with animal names and calendar names as subclasses; (4) commenorative names that are already established and given new application for honorific purposes, or from the desire to perpetuate the old name, with transfer names and saints' names as sub-classes; (5) euphemistic names; (6) manufactured names; (7) shift names; (8) folk etymologies; (9) mistake names; (10) names of folk imagination, affection, and humor.

All entries are arranged alphabetically as determined by the initial letter of the specific part: Lake Tahoe, see under Tahoe, but Pyramid Lake, see Pyramid; Mount Davidson, see Davidson. When the generic becomes a part of the specific as in the town name Mount Montgomery, the entry is under Mount. Descriptive adjectives, such as East, are considered a part of the generic also: La Plata is found under L. Group names include features of the same name, but named for various reasons, as in Copper, while cluster names have a single origin, as in Humboldt. County names, enclosed in parentheses, follow the entry if all names in the group are in the same county. Present-day pronunciations are given whenever the necessity presents itself. For practical purposes a key to the Bibliography, Maps, and Railroads has been utilized.

This state survey of some 3,000 names, representing perhaps a tenth of the name body of Nevada, makes no claim to complete and exhaustive name tracing. Approximately four per cent of the names are in languages other than English. Postulates offered on the basis of the dissertation may be later altered or confirmed, but will nonetheless serve those who in the future endeavor to expand and supplement the Nevada name story.

Microfilm $5.60; Xerox $19.60. 437 pages.

HURRIANS AND HURRIAN AT ALALAḪ: AN ETHNO-LINGUISTIC ANALYSIS.

(L. C. Card No. Mic 59-4612)

Anne Elizabeth Draffkorn, Ph.D.
University of Pennsylvania, 1959

Supervisor: E. A. Speiser

The four hundred and sixty clay tablets excavated at the site of ancient Alalaḫ in Northern Syria belong to two distinct historical levels: Level VII represents the Old Babylonian period (18th-17th centuries B.C.), while levels IV, III, and II belong to the Middle Babylonian period (15th-14th centuries B.C.). The interval between these two occupations, viz., levels VI-V, yielded no inscriptions whatever. It so happens that this same interval covers a period that is generally regarded as the so-called "Dark Age" throughout the ancient Near East. Because Alalaḫ has thus illuminated the stages immediately before and after the "Dark Age," we now have a better insight into the nature and origin of the intervening centuries. This has been obtained in two ways: (1) By studying the personal names, as an index to the ethnic composition of the state, and (2) by analyzing the local technical terminology, and to establish its meaning.

In order to determine the number of Hurrians in an otherwise predominantly West Semitic civilization, the Hurrian personal names and Hurrian terms found in the texts were analyzed for numerical and societal distribution, and were compared with the names and terms from other sites in the Near East which also contain Hurrian material.

The results obtained show that the Hurrians were well-established as an ethnic element already in level VII, and that Hurrian terminology penetrated to every sphere of activity that is treated in the Akkadian texts. It develops that Hurrians constituted nearly half of the population of Alalaḫ in the earlier period (VII), and at least three-quarters of the total in the later period; the overall penetration of the Hurrians becomes far more substantial for levels IV and following.

Although it had been previously suspected that the Hurrians were no newcomers to Northern Syria as far back as the Old Babylonian period, the material from Alalaḫ not only confirms this suspicion, but corroborates it with extensive information that has hitherto been lacking for that early period. We can now see, moreover, that the Hurrian participation in the area was by no means superficial, but proves to have been instead an integral part of the local culture for both the Old and the Middle Babylonian periods.

Microfilm $3.65; Xerox $12.40. 283 pages.

A STUDY IN FOURTEENTH-CENTURY SPANISH SYNTAX

(L. C. Card No. Mic 59-5549)

Albert Gminder, Ph.D.
The University of North Carolina, 1959

Supervisor: John Esten Keller

The fourteenth century was a period of transition for the Castilian dialect, but in many instances modern usages were already being preferred. The present participle in -ante, -iente was during the course of the century virtually replaced by the gerundive in -ando, -iendo. The use of the gerundive after en became rare. Ser was still used as an auxiliary in the formation of the perfect tenses of intransitive verbs, but the use of aver for this purpose was increasing gradually. The agreement of perfect participles of transitive verbs in perfect tenses was still evident, but the use of the invariable participle was steadily increasing. The participle used adjectivally after aver all but disappeared after mid-century, but its adjectival use after tener was common throughout the period. The simple pluperfect indicative in -ra was still a very live form, especially in intransitive verbs, but this form was still found occasionally for the preterit, and its use as a substitute for the conditional perfect and for the pluperfect subjunctive increased steadily in this century. The subjunctive was used more freely than today. The future subjunctive was still a living form, but its use in the protasis of simple conditions definitely decreased over the course of the century, the present indicative being preferred in this instance in the latter half of the period. In conditions contrary to fact in present time, the use of the conditional in the apodosis and of the imperfect subjunctive in -se in the protasis predominated throughout the whole period, the -ra form in both parts of the sentence for conditions in past time. Pronoun objects and subjects showed little change from the thirteenth century, save for increased use of le as a masculine direct object referring to a person, and the occasional occurrence of nos otros and vos otros in the second half of the century. Third-person substitutes for second person were practically non-existent. The proclitic possessive adjective forms mio to so disappeared after the fourth decade. Aqueste and aquese were now being found largely in verse. Al, atal, atanto and asaz were living indefinite adjectives and pronouns, and as indefinite pronouns dellos, entramos and omne were still common. Qui disappeared completely after the fourth decade. The interrogative and relative forms dont, ont, quan and cuemo were not to be found, though do, o and onde were still in use. With a few exceptions (problema, calor, fin, sennal, orden, arte) noun gender was by the fourteenth century the same as today. All forms of the article except those used today had disappeared completely The use of the accusative a was increasing before nouns and pronouns referring to persons, though it was not yet consistent except before the names of persons. It might still be found before que. Superfluous negation was dying rapidly, though not yet wholly gone, even by the end of the century. Ellipsis of prepositions, especially of a before infinitives, was common, and the conjunction que was occasionally omitted where it would be required today. The partitive construction was still in use. Prepositions governing infinitives after verbs were still unsettled in a number of cases. The modern word-order patterns predominated, except for the still frequent placement of pronoun objects after finite verbs in independent clauses and before infinitives following a preposition, and the still occasional placement of an object pronoun before non, or even before a subject pronoun, though the occurrences became steadily fewer.

Microfilm $2.90; Xerox $10.00. 223 pages.

STRUCTURAL DISLOCATION IN THE CONVERSATION OF HIGH SCHOOL STUDENTS

(L. C. Card No. Mic 59-3781)

Wendell Reason Starr, Ph.D.
University of Minnesota, 1958

This study was undertaken for the purpose of investigating a phase of imperfection in the spoken language of adolescents, the interruptions in syntactic structure. It was believed that such a contribution to linguistic knowledge would eventually lead to improved oral communication.

The population for the study consisted of all the graduating seniors of the St. Paul, Minnesota, Public Schools for the year 1950. To represent this population, a five per cent sample was drawn by a random process, which yielded 120 students. One boy dropped out early in the study, leaving sixty-three boys and fifty-six girls to provide the data.

The data consisted of the recorded responses of these students to a set of questions prepared and administered by an interviewer, whose intention was to elicit from each subject a thousand words of spontaneous speech.

The object of study in the data was the interruptions that broke syntactic structure. These interruptions were identified according to formal criteria. Once isolated, they were placed into two groups, those for which, through formal means, a syntactic relationship could be shown between the broken structure and the structure following it, and those for which no such correspondence could be shown. The principal criterion for declaring relationship

was situation in the included position. In the non-included position relationship was established through stress on a post-break word corresponding in position to the broken structure, through grammatical tie between broken and post-break structure, or through non-grammatical marking.

A lengthy process of examining the physical likenesses and differences among the dislocations resulted in establishment of the following categories, into which all unambiguous broken structures were placed: Replacement, (consisting of three variant types-- Single Word Replacement, Expanded Replacement, and Replacement with Different Syntactic Pattern), which exchanged a structure of one sentence function for another of identical function; Structural Overlay, which exchanged a structure of one sentence function for one of different function; Supplementation, which added modification to a grammatical sentence or to a frame; and the category non-completion, designating those instances whose post-break structures abandoned the broken structures to begin new structural sequences.

The dislocations were then given grammatical categorization in terms of the functions within the English sentence. For this purpose four functions were recognized: Predication, Complementation, Modification, and Coordination. The two systems of classification, then, provided a two-way description of each broken structure.

The results of the investigation showed more than half the broken structures to be left incomplete. The grammatical functions most frequently affected, Predication and Complementation, were abandoned in about an equal number of instances.

Thirty-five per cent of the instances were related. Of these, the Single Word Replacement appeared far oftener than any other type of relationship and three times as frequently as the two other types of Replacement combined.

These findings led to a recommendation that a study be made which would examine the structural breaks appearing in the speech of eminent persons, those whom we think of as conducting the affairs of society, those who use standard English, to provide a criterion of what might be thought of as an acceptable code of structural aberration of this kind.

Finally, a study was recommended to determine the kind of structural dislocation in the language of students both above and below the twelfth grade, to provide clues to the amount and type of dislocation that might be attributed to chronological age.

Then, with respect to classroom practice it was suggested that those structures broken and abandoned be made matters of instruction, with emphasis upon drill in the patterning of English structure.

Microfilm $9.15; Xerox $32.45. 721 pages.

A DESCRIPTIVE PHONOLOGY AND MORPHOLOGY OF COAHUILTECO

(L. C. Card No. Mic 59-6728)

Rudolph Charles Troike, Jr., Ph.D.
The University of Texas, 1959

Supervisor: W. P. Lehmann

Coahuilteco is an extinct Indian language formerly spoken in southern Texas and northeastern Mexico. Sapir treated this language as pivotal in the development of his hypothesis regarding the Hokan-(Coahuiltecan)-Siouan language super-stock. However, no descriptive linguistic analysis of Coahuilteco has heretofore been available for use in comparative-historical investigations. The present study is based on the Spanish-Coahuilteco text of a confessional written in 1760 by Bartholomé García.

A graphemic and phonemic analysis of the text yields the following phonemic system:

p	t	ȼ	č	k	k^w
p'	t'	ȼ'	č'	k'	k'^w ?
	(ϴ)	s	š	x	s^w h
	l'	l			
w			y		
m	n				
i				u	
	e		o		
		a			

Length (on vowels) and three junctures (phrase-internal, phrase, and clause) are also phonemic. The symbols /p'/, etc., indicate glottalized stops. The only initial consonant cluster is /tx/. The maximum medial cluster contains three consonants. The syllabic structure includes the following nine types: V, VC, VCC, CV, CVC, CCV, CCVC, CVV, CVVC.

The morphology is comprised of four major classes:

I. Inflected stems (there is no morphological distinction between nouns and verbs).

II. Relator-constituents.

III. Non-nuclear morphemes, including:

(a) Prefixes and infixes used with Class I stems;

(b) Suffixes used principally with Class II morphemes;

(c) Enclitics.

IV. Particles.

A short sample of edited text is given in an appendix.

Microfilm $2.50; Xerox $7.00. 148 pages.

LANGUAGE AND LITERATURE, MODERN

ENGLISH AND AMERICAN CRITICISM OF MARCEL PROUST

(L. C. Card No. Mic 59-5538)

John Newton Alley, Ph.D.
The University of North Carolina, 1959

Supervisor: Alfred G. Engstrom

The purpose of this dissertation is to present a full and methodical picture of all aspects of Proust criticism in the English-speaking countries. The field surveyed, beginning with the attention given to Proust as a result of his Goncourt prize in 1919, includes essentially the work of English and American critics published either in their own countries or in France, and that of French critics who are primarily a part of the Anglo-American literary or academic scene. This material has been analyzed in terms of the various aspects of Proust treated by these critics, and from this analysis an organization has been developed to show their treatment of Proust's characterization, main themes (society, love, time, memory, perception, art), style, and structure.

The title of Proust's master work and that of its final section have led some critics to assume that the author's aim was a fictional interpretation of the philosophical problem of Time. Yet in a truer sense the theme of time simply provides the framework on which the materials of the novel are stretched and shaped. The contrast of "temps perdu" and "temps retrouvé" epitomizes the essential antithesis of Proustian experience.

The "temps perdu" in Proust's novel has been described as the "life of action," and the "temps retrouvé" as the illumination through involuntary memory and the dedication to the pursuit of Art. The sterility of the life of action is shown in A la recherche du temps perdu through the disillusionment encountered in the treatment of the themes of society and love. The pessimistic Proustian view of human relationships prepares for and is redeemed by the revelation of the Guermantes matinée. The aristocracy is shallow and vulgar; the struggle for social prestige is vanity; friendship is empty. Love is a creation of the self, arising in uncertainty, fed only by jealousy, typified by inversion. All these things are swept away, mocked and destroyed by human time. Rare intuitions of reality are presented in works of art (Elstir's paintings, Vinteuil's music), and in chance physical sensations (trees and spires, a taste or a touch) which more rarely still are understood and freed from the contingencies of time through the metaphoric action of involuntary memory. The true artist recognizes in these flashes of perception and memory elements of his own uniquely individual reality, his patrie perdue, and he rescues them from the flow of time by expressing their eternal essence through metaphor, in the work of art.

Most critics agree that the antithesis of "time lost" and "time regained" is reflected in the form of Proust's masterpiece as well as in its content and message. A persistent charge against the novel has been that it suffered from a clashing of two discordant styles and from a disproportionate structure, both resulting from an altered emphasis in the wartime revisions and reflecting a growing pessimism in the author. Recent criticism has abandoned the theory of a changed outlook; it explains the discord and the disproportion as inherent in the two aspects of the Proustian antithesis. It accepts Proust's contention that his style is "une qualité de la vision," and finds the novel's structure as intricate and organic as in its original draft.

The most satisfying interpretations of Proust have recognized that his antithesis of constant and fundamental pessimism contradicted by a joyous message of salvation, far from constituting an aesthetic or philosophic failure, is truly the subject of his novel, and accounts for its tension, its dynamic vitality.

Microfilm $6.10; Xerox $21.20. 480 pages.

THE ARÇIPRESTE DE TALAVERA: AUTHOR AND MASTERPIECE.

(L. C. Card No. Mic 59-4492)

Allie Ward Billingsley, Ph.D.
University of Illinois, 1959

The purpose of the study is three-fold: 1) to summarize investigations previously made concerning Alfonso Martínez de Toledo (1398-1470?) and his masterpiece, the Arçipreste de Talavera (1438), also known as the Corbacho and the Reprobación de amor mundano; 2) to present in a clearer light the author, his versatility, his genius; and 3) to document as fully as possible the critical comments of literary historians concerning the work.

The study consists of three major divisions. Part I, "The Age, the Man, the Work," outlines briefly historical and cultural developments in Western Europe during the first half of the fifteenth century, summarizes biographical data concerning Alfonso Martínez de Toledo, and presents information in regard to the work itself: manuscript, incunabula, editions (both sixteenth century and modern editions), critical studies, linguistic research, and synopsis. Part II, "Alfonso Martínez de Toledo in His Masterpiece," in successive chapters introduces the Archpriest as evangelist, theologian, scholar, astrologer, psychologist, dramatist, artist. Examples drawn from the Arçipreste de Talavera are presented to substantiate each of the titles. Part III, "The Arçipreste de Talavera as a Reflection of Contemporary Civilization," presents life and customs of Castile in the third and fourth decades of the fifteenth century as they are recorded by Alfonso Martínez. Six chapters discuss, in turn, the Church, the social order, social and economic life, woman and the home, dress, make-up and adornment, and attitudes and ideas.

Parts II and III are both devoted to bringing into sharper focus the personality of the Archpriest of Talavera: his sincere religious conviction, his consuming interest in people, his understanding of human motives, his compassionate regard for human weaknesses, his boundless curiosity, his fascination with the popular language, his irrepressible volubility, his aptness of example, his keen sense of humor, his readiness of wit. They recreate a moralist devoid of sanctimoniousness, a modern religious with hopes fixed on the life eternal, but with senses attuned to the joys of the present. Concurrently, often by means of the same examples, the study goes about documenting outstanding points of the critical evaluation of the Arçipreste

de Talavera by literary historians: the Archpriest's originality in introducing into literature the language of the streets and making of it an acceptable literary form of expression, his surpassing aptitude for depicting life and customs of his age, his excellence as a psychologist, his profound knowledge of the heart of woman, his acute sense of the dramatic, his expertness (or inexpertness) as a teller of tales.

The dissertation does not provide a definitive solution to two controversial questions associated with the Arçipreste de Talavera: whether its author was sincere in stating the purpose which prompted him to write his masterpiece and whether the work is misogynic. Indeed, it may be that these questions can never be definitively settled. However, the writer does express her own belief in the sincerity of the statement of purpose and a disbelief in the accuracy of the classification of the Arçipreste de Talavera as a misogynic work.

Finally, the study, through evidence presented, concludes that the influence of the Arçipreste de Talavera, author and masterpiece, on Spanish drama has long been underestimated. It suggests that a serious investigation of the suspected influence of the prose masterpiece on Spanish drama might lead to exciting discoveries.

Microfilm $4.60; Xerox $15.40. 357 pages.

VOLTAIRE, LEIBNIZ AND THE PROBLEM OF THEODICY: FROM OEDIPE TO CANDIDE.

(L. C. Card No. Mic 59-4056)

Richard A. Brooks, Ph.D.
Columbia University, 1959

The many efforts of thinkers in the eighteenth century towards solutions to the problem of evil, whether in the context of rational theologies or of the emerging social sciences, suggest the importance of the publication of Leibniz' Théodicée and of Voltaire's later critique of Leibnizianism. The purpose of this study is to discuss the question of theodicy and the reaction of Voltaire to the philosophy of Leibniz. Particular attention is paid to Voltaire's work from the period of his early writings to the great satire of Leibnizianism in Candide. In so doing, we wish to clarify the reasons for the changing positions of Voltaire and the concern shown by the French Enlightenment in general toward one of the most vital and perplexing problems of religion, morals and society.

In spite of the existence of a significant literature on Leibniz and Leibnizianism in eighteenth-century France, knowledge of his system was incomplete and often indirect, and the French Enlightenment generally received the German philosopher with hostility because of his metaphysical and systematic point of view. Although openly opposing his philosophy, the eighteenth century nonetheless used Leibniz' ideas as a corrective to Cartesian mechanism, and actually showed an affinity with his optimism when it substituted for the idea of a beneficent God that of a chance which somehow works for the progress of mankind.

Leibniz' Théodicée presents an optimistic view of the world based on metaphysical and theological reasoning. Unlike Shaftesbury, he does not shy away from the reality of evil, for his purpose is not to disprove the existence of sin and suffering, but rather to reconcile their presence with the idea that this is nevertheless the best of all possible worlds. In contrast to Voltaire, the image we have of Leibniz in his grand effort to solve the enigma of theodicy is that of a detached and dispassionate philosopher considering a problem with which humanity is earnestly and personally involved.

Voltaire was particularly interested in discussing Leibniz' philosophy partly because of the involvement of Mme du Châtelet with Leibnizian metaphysics. Then too, Voltaire's desire to propagandize for British philosophy in France was an important factor. Moreover, his own religious and philosophical thinking, from the early Oedipe to Candide, is significantly concerned with the moral problems discussed by Leibniz. While the French writer nearly always disliked the Leibnizian philosophy, except for a brief period at Cirey, and his opinion of the German philosopher underwent no basic evolution, we may see his critique of Leibnizianism as a mirror of his particular changing attitudes toward religion and ethics. That temperament and mood are important in Voltaire's attitude toward Leibniz is illustrated by his wavering from one extreme to the other on the question of pessimism and optimism. The author of the latter on Pascal, the Mondain and the Discours en vers sur l'homme is the very same that composed Micromégas, the Essai sur les moeurs and Candide. Changes in personal environment and circumstances, rather than fundamental changes in religious or philosophic beliefs appear to be the predominant factors that must be taken into account in order to explain the polarity of Voltaire's position.

Leibniz and Voltaire, then, represent two temperamentally different approaches to the question of theodicy. Leibniz was able to explain the inevitability of evil in a finite world on the basis of abstract, metaphysical principles and with confidence in the ways of the Almighty, whatever the sense world of experience might seem to indicate. This position suggests not insensitivity to the problem of evil or naive utopianism but consistent, dispassionate faith. To the eighteenth-century as a whole Leibniz seemed to straddle rationalism and theology unsuccessfully. For the theologians his position on human liberty was insufficiently dogmatic; at the same time, it seemed dangerously to approach an amoral fatalism. For the pragmatic, social thinkers, whose radical ideas contributed to the downfall of the Ancien Régime, Leibniz' rationalsiation of the human condition and his acceptance of the status quo were indeed, in Voltaire's words, a "philosophie cruelle nous un nom consolant." The reasonable conclusion is that Voltaire's own efforts toward a solution of the problem of evil reveal a practical and humanistic approach to suffering and injustice that could not fail to set him apart from the confident system-builder of German metaphysics.

Microfilm $2.85; Xerox $9.80. 220 pages

THE IMAGE OF URBAN LIFE AS IT IS REFLECTED IN THE NEW YORK CITY NOVEL, 1920-1930.

(L. C. Card No. Mic 59-4601)

Robert Nelson Burrows, Ph.D.
University of Pennsylvania, 1959

Supervisor: Charles E. Boewe

This study is an examination of the representation of life in New York during the period between 1920 and 1930 by contemporary novelists. The study attempts to report the fullness and character of the view given in these novels of (1) the physical city, (2) urban man, (3) the jazz age, and (4) the major themes developed by these novelists, including "Migrant and Immigrant; Negro and Jew," "Success and Failure," "Marriage and Divorce," and "Religion."

In the treatment of the separate aspects of the study, the data gathered from the novels is related to the findings of sociologists and other students of the city in order to suggest the extent of agreement of the separate presentations of the nature of urban life and to indicate areas in which distortion or stereotypy may be prevalent in the novels.

Among the nearly one hundred novels set in New York City in the twenties, there are three types of works which are noteworthy for the vigor and detail with which they portray urban life. Most important of these are the panoramic novels, works which are attempts to portray the sweep of life in New York City, examplified by Manhattan Transfer and East Side, West Side. A second group, consisting of the novels which focus upon particular themes or problems especially evident in urban life, is represented by such novels as I Thought of Daisy, Uncle Moses, To Babylon, Topless Towers, and Flamingo. The third group is composed of those novels which depict life in particular districts of New York City, such as Wall Street, Greenwich Village, the Lower East Side, and Harlem, and is represented in this period by such works as The Office, Peter Whiffle, Sarah and Her Daughter, and Nigger Heaven.

The novels of New York in the twenties usually treated theme or problem most successfully in relation to a particular district of New York. Thus novels which treat the spirit of the jazz age are generally set in Greenwich Village; those which treat the problems of the immigrant are most often set on the Lower East Side; and those which best deal with success and failure often depict the financial world of Wall Street. Because such associations are typical in these novels, this study considers these districts of Manhattan in relation to the themes with which they have been most often associated.

The composite image of New York life presented in these works has its own reality and validity as a literary image and is important for several reasons: (1) This is the view of New York presented in the work of a sizeable group of contemporary observers. (2) The image of the city presented in the novel has undoubtedly had some influence upon readers, both urban and rural, in shaping their conception of the nature of urban life. (3) The image of the city as perceived by the imaginative writer forms an interesting contrast to that which has been offered by the sociologists, each having its own particular merit in the depiction of the nature of the setting and environment portrayed, and each supplementing the other in contributing to our understanding of urban life. This study is an attempt to make the image of New York City presented in the novels of the 1920's more readily available to the student of New York City of that period as well as to the student of urban life.

Microfilm $5.95; Xerox $20.80. 466 pages.

THE CARPE DIEM MOTIF IN EARLY SEVENTEENTH-CENTURY LYRIC POETRY WITH PARTICULAR REFERENCE TO ROBERT HERRICK

(L. C. Card No. Mic 59-5634)

Frederick Henry Candelaria, Ph.D.
University of Missouri, 1959

Supervisors: Dr. John P. Cutts and
Dr. Donald B. Clark

This study traces in detail the background and development of the carpe diem motif in the classical literatures of Greece and Rome. It then proceeds to show that the motif did not die out during the alleged "dark ages" of the medieval period, but instead continued to develop as a literary trope which became doubly potent when the medieval view gave way to the Ranaissance outlook, and the classics became a vital force.

The influence of the motif as it was found in the classics and the literatures of Renaissance Italy and France was felt in Renaissance England, where related literary conventions, such as the ubi sunt, sic transit gloria mundi, timor mortis, had prepared the ground for the carpe diem theme.

The motif flowered, and in the early seventeenth century it was the most popular trope in lyric poetry. The prevalence of the theme in Robert Herrick is studied and cited in support of this view. The study of Herrick showed that the theme had relevance both to the secular and religious poet because Herrick was both and used the motif in both capacities.

Major as well as minor figures used the theme throughout the period, and an investigation of their employment of the motif shows not only that the theme was wide-spread but that it also had depth, significant as an index to the thought of the times.

Micorfilm $3.65; Xerox $12.40. 281 pages.

SPANISH AMERICAN TRAVELERS IN THE UNITED STATES BEFORE 1900: A STUDY IN INTER-AMERICAN LITERARY RELATIONS.

(L. C. Card No. Mic 59-5546)

Elizabeth Rezner Daniel, Ph.D.
The University of North Carolina, 1959

Supervisor: Sturgis E. Leavitt

The significance of Spanish American travelers in the United States in the history of inter-American cultural and literary relations has never been fully appreciated. All too many writers have ignored the fact that cultural relations between the two Americas actually began in the distant colonial past of both continents.

In the period before 1830 North American interest in the Spanish colonies and their struggles for independence ran high, while visitors from Spanish America, as well as books and articles about their countries, were eagerly received. Among the notable visitors during this period were Francisco de Miranda, Simón Bolívar, Vencente Rocafuerte, José Antonio Miralla, José María Salazar, José Antonio Saco, José de la Luz, and José María Heredia.

By 1830 a measure of literary relations had been established, and through a period of fifty years they grew and developed, fostered by Spanish American travelers and by prominent North American writers. There was an interchange of ideas through letters and personal friendships among outstanding men from both Americas. Literary figures such as Everett, Tickhor, Prescott, Bryant, Longfellow and Emerson not only cultivated friendships with Spanish American writers who visited the United States, but they read their works and encouraged their literary activity. Spanish Americans in the United States and at home translated and published works of North American literature, while a few, such as Domingo Del Monte and Juan Clemente Zenea, wrote essays of literary appreciation about North American authors.

By mid-century the attitude of these travelers toward the United States began to acquire greater significance. Although there was some uneasiness about the coarseness of North American manners and the excessive devotion to money and material goods, the travelers who went home to praise and emulate "Yankeeland" far outnumbered those who did not share in this enthusiasm. Of all the travelers before the last quarter of the nineteenth century, Domingo Faustino Sarmiento was the most outstanding, not only because he returned to Argentina to attempt to recreate a nation according to his ideas of North American civilization, but because of the unique position he occupied in the history and literature of Spanish America. Among other notable travelers who furthered the cause of inter-American literary relations during this period were Domingo Del Monte, Benjamín Vicuña Mackenna, Antonio José de Irisarri, Rafael Pombo, Simón Camacho, Alberto Blest Gana, José Arnaldo Márquez, Guillermo Prieto, Nicanor Bolet Peraza, and Rafael María Mendive.

In the last twenty years of the century a tone of dislike and distrust began to color travel accounts. This changed attitude can best be seen in the writings of José Martí, the major figure in inter-American literary relations in this period and the unsurpassed chronicler of people and events in North America. His articles, sent from New York to newspapers throughout Spanish America, advocated a feeling for "Nuestra América," the America of the idealist as opposed to the materialistic and aggressive United States. Political events contributed to the change in attitude which is evident in the writings of such travelers as Rubén Darío, Rufino Blanco Fombona, José M. Vargas Vila, Pablo Groussac and Vicente Gregorio Quesada. A critical period of inter-American relations continued after the Spanish American War, and the year 1900 marked an upsurge of literary anti-Americanism, typified in Rodó's masterful and persuasive essay Ariel.

Microfilm $5.15; Xerox $18.20. 402 pages.

THE DEVELOPMENT OF THE TRAGEDIE NATIONALE IN FRANCE FROM 1552-1880

(L. C. Card No. Mic 59-5547)

George Bernard Daniel, Ph.D.
The University of North Carolina, 1959

Supervisor: W. L. Wiley

The history and mythology of the Greeks and Romans served as the main source of French tragedy until after the middle of the eighteenth century. By 1730 public demand for variety encouraged exploitation of modern history as a source for tragedy, but the use of French national history received unqualified acclaim only toward the end of the century.

From the emergence, in 1552, of French tragedy as a genre, to 1800, there were about six hundred new tragedies presented on the stages of Parisian theaters. Of this number less than seventy-five were based on events drawn from French history. There were many reasons why the tragédie nationale remained a rather insignificant branch of tragedy. The principal reason was due to the limited interpretations of Aristotle and Horace advanced by early dramatic theorists. Subsequent references to the use of French national history as a source for tragedy were rare. Among critics who did consider this field, Voltaire was the first outstanding advocate of its use. With the endorsement of the most famous dramatist of the eighteenth century, many less noted writers quickly turned to the national history for their themes. All periods of French history were equally popular.

Although it is generally claimed that the first tragédie-nationale in French literature dates from 1765, La tragédie de feu Gaspard de Colligny was really the first dramatic work that should bear that title. This tragedy served as an outstanding example of that myriad body of literature that evolved from the Protestant-Catholic controversy in the sixteenth century. From its very inception, the tragédie nationale in France seemed inexorably destined to serve primarily as a propaganda weapon used all too frequently by the French against their fellows. This was particularly true in the turbulent decade from 1789 to 1800. During that period historical tragedy and propagandistic writings, allegedly tragedies, were fused into one powerful weapon to be wielded at will against the enemy. The stage had become a veritable laboratory in which the slightest incidents from contemporary life were transformed almost instantly to form the plot of tragedies, dramas and comedies. From the more than two thousand dramatic works written during this decade, there were less than fifty which were termed tragedies. Out of this sea of productivity, hardly any name is known today. Fame, however, came to Marie-Joseph Chénier, remembered more readily because of his unfortunate brother, André, rather than for his own talents as an author.

In its development the tragédie nationale followed the same lines as regular classical tragedy, and thus was constrained because it was totally devoid of spectacle and action, two of the most salient characteristics of national historical tragedy in other nations. The main interest in the historical tragedy was the analysis of passion, usually of an amorous nature. The latter quality pointed to the ruin of the tragédie nationale even before the first strides were made in its development. As a consequence of the

all-absorbing concern with love, an historical personage was drawn at will and caused to be violently in love. The main interest of the author was then devoted to the successful solution of problems posed by the intrusion of the love element. Little attention was given to a truthful representation of historical events. In fact, with the eclipse wrought by love, history was distorted even beyond recognition. Of the fifty plays analyzed in this study, only five have any evidence of verisimilitude.

In the staging of the tragédie nationale little attention was given to historical exactitude in costume until the interest generated in it by the tragedian Talma. Had it been possible to effect costumes suitable to a given period, the efforts would have hardly been rewarded. The existence of tiered rows of benches on the stage until 1759 was a source of ready income for theaters, but impeded movement and elaborate scenery to such an extent that action in tragedy was reduced to conversation. Because of the evident lack of space, the décor usually remained the same for the entire play.

Microfilm $3.55; Xerox $12.20. 276 pages.

THE LANGUAGE OF AMERICAN POETRY, 1900-1910.

(L. C. Card No. Mic 59-6633)

Frederick Willis Eckman, Ph.D.
The Ohio State University, 1954

In the crucial first decade of the present century American poets were struggling to find a language which would better express the realities of their time than the one currently available to poetry. For over a century the mainstream of English and American poetry had been Romantic: poetry based on a half-mystical belief in inspiration, motivated by a desire to communicate emotionally, and thus often hostile or indifferent to precision of language. As the nineteenth century went on, Romantic language lost its original freshness and became merely a conventionalized diction. By 1900 many poets found it increasingly difficult to cope with a trite vocabulary of vague emotionalism, an affected, oratorical syntax, and a conventional and decorative imagery. The bolder spirits among them were attempting to rejuvenate poetry (1) by a return to the plain language of prose—either the spoken idiom or the language of realistic fiction, and (2) by development of a precise, often realistic, imagery integral to the structure and meaning of the poem.

In The Romanticism from which twentieth-century poetry grew there were two ultimately conflicting theories of poetic composition. One was deeply concerned with matters of technique; it insisted upon a careful choice of language, an abundance of concrete imagery, and workmanlike attention to metric. The other theory held that poetry had its source in inspiration, that its medium was emotion, and that its highest purpose was the expression of a lofty moral idealism. This theory generally found attention to language and other matters of technique a hindrance to free poetic expression. These two theories did not become mutually repellent until late in the century; hence we often find the early Romantics professing belief in first one, then the other. One means of compromise, exploited by such poets as Tennyson, Swinburne, and Lanier, was the retention of an emotionalist-idealist subject matter within the framework of various experimental metrical forms. The view which opposed close attention to technique came to dominate nineteenth-century poetry; in language the result was a conventionalized poetic diction and an indifference to structural precision.

Out of these conflicting theories arose four modes of Romantic poetry. These I have named emotional, euphonic, concretive, and idiomatic. The first mode, which dominated nineteenth-century poetic practice, arose directly from the inspirational-emotional-idealist theory of poetry. It was characterized by a vocabulary heavy in abstractions and in words describing emotional states, as well as in other terms with strong associational values. Its syntax resembled the flowing periods of contemporary oratory and its imagery was often either deficient or defective. After Wordsworth the emotionalist mode made a slight use of idiomatic language, in either vocabulary or syntax.

In the euphonic mode, an attempt to resolve the two conflicting theories of poetic composition, poets were able to write an emotional poetry and still, in a limited sense, devote some attention to technique. This mode exploited sound, by means of metric and such traditional literary devices as rhyme, alliteration, and vowel harmony. Its chief defect was a willingness to sacrifice meaning to auditory beauty. The concretive mode arose from the desire to "clothe ideas in images." Often, when pressed into the service of emotionalism, it depended heavily on evocative rather than precise imagery. By the end of the century its imagery typically had become either trite or opulent. But in all cases the concretive mode avoided abstractions and tended toward a more direct syntax.

The idiomatic mode had its origins in Wordsworth's celebrated "language of real men"; but its progress in the nineteenth century was erratic. Browning was probably its chief practitioner, although the American dialect poets also advanced its position. Its vocabulary is based on short, Saxon words; its syntax approaches the directness and simplicity of colloquial speech; and its imagery tends to be realistic, often stark and unemphatic. This mode, more than any other brought about the rejuvenation of poetry in the early twentieth century.

In examining eight representative poets of the 1900 to 1910 decade, I have noted various developments of these four modes. The poet's own statements about language are in each case an aid to understanding his use of words, and his metrical practices give further insights into his use of language. Selective word lists (principally nouns, adjectives, and verbs) show each poet's relation to the nineteenth-century vocabularies of emotionalism, indefiniteness, abstraction, the conventionally "poetic," and the colloquial or idiomatic. I have discussed syntax in its relation, respectively, to the grand manner (periodic sentence structure, rhetorical question and outcry, circumlocution, and other devices of oratory) and to the idiomatic manner of the spoken voice. In the imagery of this period I have demonstrated a range from the vague, misty, and inadequate concretion of much emotionalist verse, through the gilded opulence of an ornate visual poetry, to the realistic or functional images which characterize contemporary poetry.

The poetry of George Edward Woodberry, George Sterling, and George Santayana is an accurate reflection of conservative language practice in the period. While generally

more ambitious in theme and conception than the genteel effusions of Stedman, Aldrich, and Gilder, this poetry relied almost totally on the available language of the late Romantic mainstream. Woodberry, the oldest of the three, used many Swinburnian and Tennysonian devices of euphony; his vocabulary is heavy in conventional evocative diction; and the lushness of his imagery links him with the Pre-Raphaelites. His syntax is less rhetorical than that of Sterling, but he seems to have avoided any sustained contact with the idiomatic mode. Sterling, a poet who developed his craft in the relative isolation of the West Coast and under the conservative tutelage of Ambrose Bierce, used a vocabulary heavy in abstractions and personifications. Neither euphonist experimentation nor the late Romantic tradition of metaphorical opulence affected him greatly, although in one long poem ("A Wine of Wizardry") he reveled in the imagery of fin-de-siècle satanism. Otherwise his imagery was vague and misty, or conventional to the point of triteness. Sterling's syntax reveals his indebtedness to Romantic rhetoric: the long, rolling period and other familiar marks of oratorical expression. He rarely was direct and forthright, either in vocabulary or in syntax.

Santayana, because he wrote a poetry of clearly defined ideas (and perhaps because he was more than usually cautious about using a language not his native tongue), was able to use the available language with more precision than most of his conservative contemporaries. Though all the elements of emotionalist poetry are in his work and though his imagery was frequently derived secondhand from literature, Santayana's use of such devices as irony and antithesis gives a firmness to his work not often found in that of other conservative poets. Through the medium of light verse Santayana proved himself to be a competent worker in the idiomatic mode—a fact not generally known.

William Vaughn Moody, George Cabot Lodge, and Trumbull Stickney are representative of a whole generation of poets who vacillated between the readily available but outworn language of Romanticism and the largely unexplored possibilities of a new idiom. Although each of these three poets developed an individual style, all of them reveal the same indecisiveness: an urge to experiment, coupled with a reluctance to abandon tradition. Moody's greatest gift was that of metaphorical fluency, but he was never able to extend this talent beyond the Pre-Raphaelite manner of decorative opulence. From time to time he achieved a forthright syntax, freed of Romantic rhetoric, and a plain vocabulary, stripped of emotional vagueness; but he could not sustain the effect. He seems to have admired the grand manner of Milton too much. Lodge's language is marked, like Sterling's, by a predominance of abstractions, aureate diction, and a highly formal syntax reminiscent of the pulpit or the rostrum. In his attempt to write a poetry of social consciousness as well as a poetry of more than ordinary philosophical complexity, Lodge is a modern; but he, too, found euphonic felicities, emotionalist diction, and rumbling Ciceronian periods too attractive to abandon. Trumbull Stickney tried to use language with more precision and originality than either of his two friends. His poetry wavers, however, between extremes of irony and sentimentality, with the latter ultimately ascendant. Stickney's imagery shows a considerable advance over any we have so far examined: it is often precise and imaginative, seldom merely decorative. Related to this precision and utility of imagery in Stickney is his ability at times to create an unaffected idiom based on the syntax and rhythms of spoken language.

The work of only two American poets in the decade 1900-1910 still remains as more than an historical survival of that troubled period. Edwin Arlington Robinson and Ezra Pound, working by different means, were able to throw off the curse of decadent Romanticism and develop a poetic language adequate for the realities of modern life and thought. By adapting to poetry the unaffected vocabulary and straightforward syntax of realistic fiction, and strengthening them with a structure more syllogistic than narrative, Robinson developed a terse, complex poetry. His constitutional dislike of artificiality and emotional excess helped him to rid his vocabulary of the Romantic diction that had blighted the work of talented poets like Moody and Stickney. Pound began his career by attempting to isolate the positive qualities in late Romantic poetry (verbal and visual beauty, command of metrical technique) and to fuse them with a new esthetic—that of medieval European poetry: Provençal and Italian. The vocabulary of Pound's early work reflects his deliberate exploration of archaic language, an attempt to escape the triteness of Romantic diction (something he did not always succeed in doing). The syntax of his early poems is either consciously archaic or idiomatically direct, but in later years only traces of archaic construction would linger in Pound's work. From Dante and Cavalcanti Pound learned two facts important to his use of language: (1) imagery must function in the poem and not be merely ornament, and (2) emotions can be expressed precisely if they are really felt or thoroughly imagined. Pound's greatest contribution to modern poetry appears to be his exploration of metric: he developed "free" forms that would catch the irregular rhythms of the spoken language.

For a period in which so little of permanent value has survived, a surprising number of poets were actively writing. The elder poets of the genteel tradition, Gilder and Stedman, still published in the magazines, and set standards of conservative taste. Among younger poets who clung to established poetic language were Madison Cawein, Josephine Preston Peabody, and a group of clever but shallow technicians, or whom Guy Wetmore Carryl, Frank Dempster Sherman, and Clinton Scollard are typical.

Transitional figures included Anna Hempstead Branch, Arthur Davidson Ficke, Edwin Markham, Lizette Woodworth Reese, and Ridgely Torrence. Each of these poets was able, from time to time, to strike an individual note; but in the main they were as indecisive as their contemporaries, Moody, Lodge, and Stickney. In the work of these writers we find the same wavering between old and new; florid and plain, vague and precise by turns, they were not certain which way to go. Of more immediate interest are the poets whose work would figure importantly in the "renaissance" of 1912 and after: "Webster Ford" (Edgar Lee Masters), Wallace Stevens, Amy Lowell, William Carlos Williams, Sara Teasdale, Vachel Lindsay, Robert Frost, and T. S. Eliot. Of these, Masters and Stevens were the most conventionally Romantic, while Frost and Eliot show the greatest degree of freedom from outworn tradition. In most of these poets, however (and especially in the latter two), one can detect signs of individual poetic idiom.

In the twenty years after 1910, American poetry, having emerged from the decadent gentility of the late nineteenth

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

century, began by a process of trial and error to develop its own poetic language. Except for transformed survivals in poets like Millay, Cummings, Crane, and poets of the short-lived proletarian movement, the Romantic emotionalist mode no longer existed as a major force in poetry. The euphonic mode, at least as it had been known to the nineteenth century, also suffered a decline. A poetry of concretion thrived, but it was no longer merely ornate; functional imagery (mainly through the impact of French Symbolism) became a necessary part of poetry. Steadily through the century the idiomatic mode thrived; its variations ranged from the delicate cadences of Pound and Eliot, through the artless thunder of Lindsay and Sandburg, to the stripped "anti-poetic" manner of William Carlos Williams. In its struggle for freedom from Romantic language, American poetry became for the first time in its history a powerful force in world literature. Modern literary theory, with its great concern for problems of language, its concept of the poem as linguistic object, has set the pace for these new ventures.

Microfilm $4.35; Xerox $14.60. 338 pages.

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THE LIFE AND WORKS OF JOSÉ MILLA Y VIDAURRE

(L. C. Card No. Mic 59-6604)

George John Edberg, Ph.D.
University of Kansas, 1959

Adviser: Professor Seymour Menton

Although two earlier dissertations have treated the important nineteenth-century Guatemalan writer José Milla (1822-1882), this study is the first to take into account his entire literary production. Chapter I, a biography of Milla, presents some hitherto unknown facts and relates the author's life and times to his works.

The second chapter analyzes Milla's cuadros, which were not only his favorite but also his best and most typical works. Published in collections called Cuadroa de costumbres guatemaltecas, Libro sin numbre and El Canasto del sastre, all the sketches are really artículos according to modern classification. Within them Milla discusses some typical aspects of Guatemalan life and certain well-defined Guatemalan types. Undoubtedly influenced by Larra and Mesonero Romanos, particularly the latter, he still demonstrates considerable originality. The good-natured humor, which prevails throughout, is achieved by concocted names, humorous incidents and plays on words. Many of the individual artículos are interdependent because of similar themes, types and names. Five of them describe the adventures of the rustic Tío Climas while "El esclavo de don Dinero" is actually an attempt to expand them into a novel.

Chapter III is concerned with Milla's five historical novels, published between 1866 and 1882. It distinguishes between the historical and fictional elements of the novels and classifies their romantic devices, many of which were suggested by the Spanish Romantic and Golden Age theatre. Milla's first three novels are based on well-known colonial episodes. El Visitador, the last of the three, deserves to rank among the best of its kind in all Spanish America. Milla's next novel, Memorias de un abogado, is a definite attempt to give up romanticism for realism, but in his last work, Historia de un pepe, Milla reverts to the romantic formula employed earlier. Despite the conventional plots and devices, and the lack of psychological penetration and development of character, the reader's interest is maintained at a high pitch by a series of well-written, dramatic episodes full of mystery and suspense.

Chapter IV discusses Milla's historical writings, in particular, his two-volume Historia de la América Central. Although Milla was familiar with the philosophical interpretation of history propounded by Montesquieu and others, he was mainly interested in the story value of an event, inserting anecdotes and painting adventurous deeds of important figures with large dazzling strokes. This work has received great praise from subsequent historians and is considered indispensable for anyone undertaking a study of colonial Central America.

Chapter V treats Un viaje al otro mundo, a three-volume account of Milla's travels in the United States and Europe. Both autobiographical and fictional, its purpose is to instruct and entertain. The factual part of the book revolves around the mishaps of Juan Chapín, the author's traveling companion. The creation of this character who has since become the Guatemalan prototype is the most significant single contribution of the Viaje. Juan Chapín, in addition to bearing a strong resemblance to Sancho Panza, at times assumes a Quixotic pose.

The sixth and final chapter evaluates Milla's poetry, which although suffering in comparison with his prose, is richer and more extensive than is commonly supposed. The fact that many of Milla's early poems contain the same elements that were to earn acclaim for him in later works give them importance in the appraisal of his total literary production.

Milla's writings may be neatly divided according to genre, but they all have much in common: benign humor, exaggerated situations and types, moral purpose, reverence for the past, interesting narration, clever handling of language and a clear, smooth-flowing style. Many of his works have survived the test of time and are still read and enjoyed today. In addition to their intrinsic value, they are important for having laid the foundation for Guatemalan literature.

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SWIFT'S RELATIONS WITH ADDISON AND STEELE

(L. C. Card No. Mic 59-5180)

Bertrand A. Goldgar, Ph.D.
Princeton University, 1958

This thesis presents a detailed account of the personal, political, and literary relations between Swift and two of his major contemporaries, Addison and Steele. Its emphasis rests upon the political, for most obviously their early friendship was doomed by the "curse of Party." Yet it is possible that underlying the surface of their clash over politics are fundamental differences in taste, temperament,

and intellectual outlook. The Introduction explores this possibility by examining the attitudes of Swift and his Whig friends toward such intellectual issues as the role of experimental science and the cluster of ideas about the nature of man which underlay the literature of sensibility. This section thus places their quarrel over politics in a context of contrasting intellectual and literary traditions.

The main body of the study is an exposition, organized chronologically, of the specific personal and political relationships among the three men from their first meetings in 1708 to Steele's death in 1729. The first Chapter considers Swift's visit to England in 1707-1709. This is the time of Swift's closest friendship with the Whig wits, but the literary fruits of that friendship are negligible compared to the tracts which he wrote or revised in 1708 in support of the Church. While Addison and Steele were consolidating their position as rising Whig politicians, Swift was becoming increasingly disillusioned with the ecclesiastical policies of the Junto. To the extent that political differences were responsible for the rupture of his friendship with Addison and Steele, it may be said that the break was beginning at the very time when the friendship seemed most strong.

The political crisis of 1710 resulted in Swift's so-called "conversion" to the Tories, which is analyzed in Chapter Two. Now the writer of the Examiner, he found it increasingly difficult to maintain cordial relations with the Whig writers, who deeply resented his efforts to obtain patronage for them. In the following two years, when Addison and Steele were writing the Spectator, the estrangement continued. The third Chapter traces the manner in which each new political issue made manifest their conflicting loyalties and interests.

In the last two years of the reign of Anne, a series of issues centering around the Tory peace and the Protestant Succession brought domestic politics to a point of extreme tension. Chapter Four examines the roles of Steele and Swift as the leading journalists of their respective parties. Their quarrel was now bitter, and as the party warfare increased in intensity their private differences became a matter of public comment and exploitation. A critical analysis of Swift's satiric attacks on Steele reveals the superiority of his techniques as a political satirist and propagandist, and research into the background of their disputes over specific issues indicates that Swift's attacks are grounded not merely in personal animus but in political principles quite different from Steele's. With the death of the Queen and the collapse of the Tories, the diversity of their fates made impossible a return to the amicable days of 1708. Swift and Addison, however, did resume friendly relations, though they never saw each other again.

An attempt has been made throughout to show that their estrangement was the result of the basic opposition of their interests. Addison and Steele were primarily men of affairs, place-seekers committed to particular political leaders. Swift was first of all a clergyman, loyal to his Church and to that "party" which he felt would best secure the Establishment. The conflict of these loyalties was quite sufficient to destroy a friendship and turn literary talents into political weapons.

Microfilm $3.75; Xerox $12.80. 292 pages.

HAROLD FREDERIC: A CRITICAL STUDY OF THE AMERICAN WORKS.

(L. C. Card No. Mic 59-5311)

Charles Bernard Hands, Ph.D.
University of Notre Dame, 1959

The purpose of the dissertation is to examine the American works of Harold Frederic in order to evaluate him as an artist. The writer finds that Frederic's first novel from the point of conception, In the Valley, was a product of his knowledge of his own regional background, and was a fairly conventional piece of historical fiction. Details were accurate, but the characters were wooden, and the structure academically rigid.

In Seth's Brother's Wife Frederic tried unsuccessfully to move into the Howellsian current of contemporary realism. He leaned heavily upon his own experience, and wrote vividly about the things he knew, but he did not have the artistry to sustain his effort. He botched his major characters, mishandled his point of view, and lacked either the acumen or inclination, perhaps both, to carry the novel's promising beginning to a successful conclusion. His inexperience also is evidenced by his inability to sustain interest in all the levels of the story simultaneously, and by his inability to handle significant imagery.

In The Lawton Girl Frederic showed substantial improvement. His attempt to deal with the impact of industrialization upon a small town brought him closer to important contemporary themes, and the structure of the novel was much tighter. The novel is noteworthy for the excellent job Frederic does in probing the weaknesses of Horace Boyce. He had exhibited an inclination toward psychological examination earlier, and now his firmer grasp of realistic techniques enabled him to succeed. The Lawton Girl also uses substantial imagery to help forge the industrial problem and the characters' personal problems into an organic whole.

The serious Civil War stories indicate that Frederic had mastered his realistic medium. Their evocation of atmosphere is firm and sure; the characters are drawn deftly. In addition, Frederic, especially in Marsena, showed he had mastered the use of irony as a means of conveying meaning. The Damnation of Theron Ware is a mature synthesis of all these factors. It deals with a serious contemporary problem--religion--by showing the decay of a weak but well-intentioned minister. The dramatic quality is enhanced by a point of view ideally suited to tracing the minister's decay, and by a complex but well-conceived set of images. The sources of the novel are analyzed to show Frederic's use of them. It is concluded that the artistry of the novel and the handling of the themes should dispel any notions that Frederic was a journalistic hack writing fiction only for money, or that Frederic was a naturalist.

The writer indicates that Frederic's range was narrow, but that his narrowness was also his strength, since it enabled him to achieve a concentration not characteristic of Howells. His narrowness kept him from being a second-rate Howells, since it enabled him to explore the fatal self-divisions in man for their own sake rather than for the effect they have upon society. In this way Frederic was different in original and significant ways. Later writers were to exploit successfully a number of Frederic's themes, but Frederic cannot be said to have influenced anyone.

His only claim to fame is that he wrote a half-dozen excellent short stories and novelettes, and a truly first-rate novel. Many writers have achieved greater fame for doing less. Microfilm $3.65; Xerox $12.40. 281 pages.

ALBION W. TOURGÉE: CRITIC OF SOCIETY.

(L. C. Card No. Mic 59-4011)

Martin Ernst Hillger, Ph.D.
Indiana University, 1959

His fourteen years residence in North Carolina convinced Albion W. Tourgée, soldier, lawyer, judge, and author of novels of the Reconstruction period, that the terms North and South designated two civilizations. With this contrast in mind, he wrote regional stories--e.g., A Royal Gentlemen, Figs and Thistles, and A Fool's Errand--that reflect the fundamental social differences he associated with the two regions: the freedom and hustle of the industrial North, the rural ease of the aristocratic South.

In customary local color fashion, his characters are typical of their regions in speech and dress, but in a more profound manner their thinking and behavior are determined by society. Since Tourgée conceived of determinism as necessary cause, not fate, his characters are not robots but people of flesh and blood possessed of the stresses and tensions of their environments and a sectional coloring of thought and action.

Regional contrasts found their way into not only Tourgée's characterization but also his representation of the institutions of the nation. In A Royal Gentleman he depicted Southern planters as setting up a caste system which restricted their freedom to act in conformity with their own deepest feelings while countenancing the sexuality which ironically mocked their attempts at segregation. This same system produced the social groups whose antagonisms made chaos of Reconstruction: the "Tories," loyal to neither side; the loyal Unionists; the inflexible planters, determined to retain the old ways; and the newly freed slaves. The North he found given over to materialism, greed, and corruption, as he indicated in Figs and Thistles and Murvale Eastman. In both sections it was the manner of organizing society that was to blame.

Tourgée advanced concrete plans for dealing with the problems vexing both North and South. In A Fool's Errand, John Eax, and An Appeal to Caesar, he outlined a two-pronged attack on the South's perennial problems, poverty and ignorance. He proposed to fight poverty by replacing outworn agrarianism with modern industry based on the region's rich resources. The simple mention of the South's 45 per cent illiteracy rate was cause for men to reach for spelling books. Tourgée went further by calling for national aid to education, arguing that illiteracy in the South was a result of slavery, for which the entire nation was responsible.

The plan Tourgée developed in Murvale Eastman for counteracting the materialism and greed of the North included an attack on the inhumanity of laissez-faire industrialism. He denounced historical Christianity for serving as a prop for such economic inequality as the amassing of huge fortunes by the aggressive members of society while others lived in poverty. Rejecting communism as hostile to individual responsibility, Tourgée suggested that Christians bear one another's burdens by working for governmental control of the economic system and by insisting that the Church stop supporting society as it is in favor of society as it should be.

Tourgée clearly possessed both the social critic's perception of human limitations and his compassionate desire for social betterment.

Microfilm $4.25; Xerox $14.20. 329 pages.

ROMANTIC LOVE IN MAJOR AMERICAN NOVELS: 1789-1860.

(L. C. Card No. Mic 59-6200)

Charles Edwin Howard, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor George Neil Bennett

Of the social and cultural aspects of American life which have informed the American novel, one of the most important has been romantic love. The essential tenets of this social concept are the following: (1) freedom of the individual in the choice of marital partner; (2) love as the one requisite of marriage; (3) marriage as the one true source of happiness: (4) aesthetic appreciation and idealization of woman. The "romanticism" of this concept historically consists in its rebellion against familial arrangement and control of marital matters.

In America all conditions coalesced to create a climate for the luxurious proliferation of this concept. Protestantism dominant in America upheld marriage as the approved state of man and those of love the strongest bulwark against the sex sins spawned by patriarchal loveless marital contracts. Economic abundance and opportunity in America freed the individual from family dependence and control. American political philosophy recognized individuals rather than families and insisted on marriage as an individual affair formed on the basis of individual rather than familial criteria.

The earliest novels of America, seeking to portray the actualities of the society from which they evolved, posed the question as to how the new marital freedom should best be used. American novelists found in the works of Samuel Richardson a somewhat parallel concern with questions of marriage, an acceptable morality, and a congenial form. In imitation of Richardson's epistolary frame, but with social interests indigenously American, the earliest novels were concerned with social relationships that began and, if the characters were successful, ended in the home. Heroes and heroines found in marriages of love their greatest reward. Villains sought for selfish reasons to attain some of the gratifications of marriage without its responsibilities, or sought marriage itself for less admirable reasons than love. However, at best, a moralistic conception of literature forced the early novelists to depict heroines "ruined" by hearts too gullible or heads too filled with visions of wealth. At worst, a desire to be sensational initiated an excessive display of sex, seduction and suicide--all the result of love misplaced or misguided; but no one doubted the importance of love in marital decisions.

At the turn of the century, Charles Brockden Brown

utilized romantic love as the principal entree into the mind of his most mature character, Constantia Dudley; women's rights and the place of love in marital determination are the primary thematic concerns of Ormond; or the Secret Witness.

In James Fenimore Cooper's Leather--Stocking Tales, romantic love is a basic ingredient of American civilization which, as it moves westward, subdues the heroic but socially less desirable modes of life on the frontier. Natty Bumppo first makes his choice of frontier non-civilization in terms of a refusal of marriage. Later his attempt and failure to revoke this choice is dramatized in terms of his courtship and loss of Mabel Dunham.

The novels of Nathaniel Hawthorne depict a conflict within the soul of man between that which would restrict him to harsh and narrow limits and the affections which would bring absorption into the social scheme. The most recurrent framework for this conflict is the relationship between lovers, and the most frequent symbol of the individual's absorption into society is a marriage of love. Not only does love redirect Hawthorne's socially wayward characters, but it humbles the proud, humanizes the impossibly idealistic, and strengthens the weak; or it fails to do so because they reject love and thus suffer the torment of isolation. Time and again in Hawthorne's novels the gloom of hell fire is juxtaposed against the cheerfulness of the fireside hearth.

Microfilm $6.25; Xerox $21.60. 490 pages.

MILTON'S HERMENEUTICS: A STUDY OF SCRIPTURAL INTERPRETATION IN THE DIVORCE TRACTS AND IN DE DOCTRINA CHRISTIANA.

(L. C. Card No. Mic 59-5557)

Theodore Long Huguelet, Ph.D.
The University of North Carolina, 1959

Supervisor: Almonte C. Howell

In view of John Milton's repeated avowal of dependence upon Scripture alone in theology, there is a need for ascertaining the principles and methods which he recognized as guides in Scriptural exegesis. A study of the major theological works--The Doctrine and Discipline of Divorce, Tetrachordon, and De doctrina christiana--reveals that Milton adopted the standard Protestant rules of hermeneutics and amplified them according to his own observations and insights.

The starting point of Milton's theory of interpretation is the doctrine of the perspicuity and inerrancy of Scripture. Milton could not doubt that the written Word, having been designed for the good of man by a just and all-wise God, is clear, unerring, and sufficient to teach doctrine to all men. Milton also believed, as a second principle of hermeneutics, that every Christian has the right and the ability to interpret Scripture for himself, with the aid sometimes of "ordinary" and "extraordinary" ministers. Regenerate Christians are given the power of comprehending spiritual matters through the aid of the Holy Spirit, but each Christian is expected to search the Scriptures by means of reason and learning. Milton also accepted the Protestant rule that the public interpreter must be able to inspect the Scriptures in their original languages. Milton himself was skillful in Greek, proficient in Hebrew, and perhaps acquainted with the rudiments of Syriac and Aramaic. Contrary to expectations, however, Milton makes no extensive use of technical philology in exegesis.

Milton's expositions of Scripture are generally based upon reason and the ordinary reading skills. As for the different levels of meaning in Scripture, Milton accepts the one "historical sense," expressed literally or figuratively, while he also recognizes that in certain Old Testament texts the historical sense is compounded with the "typological sense," prefiguring Christ and the Gospel. Another presupposition underlying Milton's exegesis is the belief that the universal laws of nature and reason are inherent in the written Word. Man's reason is directly commensurate to reason in the Bible, and the laws of nature implanted in man may verify interpretations of natural laws implied in the Bible. Formal logic is also useful to elucidate texts, for the Scriptures are perfectly logical.

Finally, Milton perceived that the Scriptures teach according to the law of method, whereby clear texts and the axioms of doctrine guide the interpreter from universals to particulars. The supreme axiom of Christian doctrine, according to which all utterances in the New Testament must be interpreted, is charity. In the divorce tracts, expecially, the rule of charity becomes Milton's version of the final and culminating principle of hermeneutics, "fidei analogia," or interpretation of individual texts in the light of the supreme rule of Evangelical doctrine.

Microfilm $3.65; Xerox $12.40. 281 pages.

A STUDY OF THE LITERARY REPUTATION OF ANTHONY TROLLOPE, 1847-1953.

(L. C. Card No. Mic 59-5388)

Iva Gwendolyn Jones, Ph.D.
The Ohio State University, 1953

The observations that Anthony Trollope was a popular novelist during his lifetime, suffered an eclipse after his death, and emerged to enjoy a remarkable renascence in the twentieth century have become commonplaces in Trollopean criticism. Strangely, no study has made a detailed examination of the contemporary and posthumous reviews of Trollope's novels in order to test the validity of these statements and to determine what the critics thought to be the extent and quality of his artistry and the bases upon which his permanent reputation might rest. Therefore, it is the purpose of the dissertation to consider the reviews of Trollope's novels and the critical comments made about him from 1847 to 1953; to evaluate the criticism by isolating the shortsighted and trivial judgments from the perceptive and defensible; to cite the prevailing tendencies in the criticism; and to suggest the extent of his popularity.

The conclusions of this study establish the controlling critical tendencies within each category of Trollope's artistry--subject, characterization, plot, style, and evaluations of his reputation.

In each of the five chronological periods,[1] extending from 1847 to 1953, the criticism of Trollope's treatment of subject shows an amazingly consistent development,

excepting for deviations upward during the second and fourth periods. The critics praise continually the moral lessons deduced from and his fairness toward subjects, and they give thoroughgoing praise to his photographic depiction of Victorian middle-class life. In the second and fourth periods, the critics hail his perceptive knowledge of the organism of society, revealed in his pictures, as the "cornerstone" upon which his permanent reputation may rest. Likewise, there is equal consistency in the negative evaluations of his treatment of subject. In each period, the critics regret his superficial knowledge of such subjects as the law, theology, colonization, North America, biography, and politics. They inveigh equally against his treatment of painful and sordid subjects — the plight of Ireland, boarding-house life, the Vendean conflict, and the vulgar whereabouts of commercial travellers.

A striking fluctuation occurs in the critical attitudes toward Trollope's power of characterization and his characters. From 1847 to 1862, the critics approve Trollope's female characters, and, excepting his clergymen, the critics approve his male characters. The majority of the critics in every period are either lukewarm, sharply opposed, or indifferent toward Trollope's clergymen. However, the critics, in the main, deal harshly with Trollope's characters in the second and third periods. In view of the fact that these periods embrace the greatest span in Trollope's lifetime, the critics' resentment toward his characters is prima-facie evidence that society was not impressed, the traditional belief notwithstanding, with the reflections from the mirror, which Trollope held up to nature. In these middle years, the critics find Trollope's women distinguished for their dullness, stupidity, stiffness, fidelity, and coarseness; and his men equally distinguished as hobbledehoys, vacillators, cads, prigs, and villains. Nevertheless, there is a shift in the critical attitude toward the characters in the last two periods, from 1883 to 1953. The critics agree that Trollope's power of characterization is one of his chief strengths. The attitude of the critics toward Trollope's surface sketching of character follows a peculiar line of development from 1847 to 1953. In the first three periods, 1847 to 1882, his surface sketching of character, rather than depth portrait painting, is considered an asset, but in the last two eras, his sketching comes to represent errant superficiality. Paradoxically, however, many critics in the 1940's find that Trollope's chief compelling interest lies in his skillful, if superficial, delineation of average humanity.

The prevailing tendencies in the criticism show that Trollope could ill afford to permit himself the luxury of abandoning dramatic plot. Excepting a preponderance of favourable comments about his plots from 1883 to 1953, the critics in each period attack his plots because of their padding, overtreatment, digressions, violation of story illusion, use of false contrivance, indulgence in authorial exegesis, repetition of pattern, and flimsiness. Typical of the general critical reaction is the remark of one exasperated reviewer that Trollope has the distinction of being able to do what no other man can do— write a story about absolutely nothing. And yet, although the criticism is largely hostile to the substance, structure, and technique in Trollope's plots, excluding the years from 1883 to 1923, the critics give high praise to particular scenes. Only with the revival of Trollope during the last two decades does one find critics attempting to justify plots, which even Trollope in his casual attitude toward art, recognized as particularly defective.

Developing inversely with plot, Trollope's style, until the last two periods, is evaluated positively by the critics. Even though the evaluation of a single critic may contain both favourable and unfavourable claims about Trollope's style, the overtones often suggest that the critic cannot resist the magnetic charm and easy intelligibility of this "trotting Pegasus." The critics welcome consistently the clear, plain, photographic, brisk, flowing, humorous, delicate, simple, and readable style of Trollope. Simultaneously, many critics are piqued by his carelessness, prolixity, slowness, and commonplaceness. Since 1883, the critics show a tendency to admit the limitations of Trollope's style and then to show why it should be acceptable.

The criticism seems to support the fact that from 1847 to 1882 the critics consider Trollope as a mere journeyman novelist, a second-rate "shoemaker" craftsman, lacking in the elements requisite for a great novelist and artist; a writer whose wares are marketable and amusing, but a writer whom no critic would take seriously because he never seems to get his artistic sea legs. Nowhere in the contemporary criticism does one find a single fullfledged tribute to Trollope's art such as one might expect for a first-rate novelist. There are generous concessions, a willingness to show that Trollope can surpass Dickens and Thackeray in certain regards, but always Trollope is something less than the fiction writers in the great Victorian trinity. After an eclipse, extending from 1884 or 1885 to 1900 or 1901, Trollope, as a result of the proddings of scattered enthusiasts and scattered reprintings of his n novels, emerges. His reputation experiences no appreciable rise or fall between 1900 and 1930, although the interest in him is continuous if narrow. The 'thirties and 'forties bring Trollope's vogue to full maturity -- a maturity involving a popularity from 1944 to 1948 which is restricted in scope largely to a few cliques of intellectuals and bibliophiles. However, Trollope is doubtless read by the common man, but evidence proving the fact is not forthcoming. Nevertheless, Trollope's novels have an inherent validity for "all time" which makes the fact inconceivable that he will ever again know oblivion, and the evidence available to this study makes it equally inconceivable that Trollope will be canonized among the great writers of fiction.

Microfilm $5.55; Xerox $19.60. 436 pages.

1. 1847-1862; 1863-1876; 1877-1882; 1883-1923; and 1924-1953.

Abstract published by special arrangement with The Ohio State University.

LA ACTITUD PICARESCA EN LA NOVELA ESPAñOLA DEL SIGLO XX. [SPANISH TEXT.].

(L. C. Card No. Mic 59-5260)

Betty Rita Gómez Lance, Ph.D.
Washington University, 1959

Chairman: Sherman H. Eoff

This study undertakes an explanation of the recurrence and continued popularity of the picaresque tradition in Spanish literature. The twentieth century novel is used as a basis for an examination of the picaresque attitude in relation to general social and economic conditions.

The first step is to define the pícaro in terms of basic motives and patterns of adjustment and then to advance a hypothesis as to the roots of picarismo. The following hypothesis is presented: extreme poverty plus an extreme authoritarianism of Church and State, working together, produce picarismo. In order to test this hypothesis, an analysis is made of the Spanish novels in the twentieth century that have been or could be called picaresque. The century is divided into three periods, based on the major political situations: Spain from 1898 to 1923, the monarch in control; Spain from 1923 to 1939, the dictatorship of Miguel Primo de Rivera and the Second Republic; Spain from 1939 to 1959, the dictatorship of Francisco Franco. After an analysis of the novels in each epoch, note is taken of the political, religious, economic and intellectual atmosphere of the period in question, with special attention to the basic factors in the hypothesis.

The results seem to indicate that we may accept as valid the explanation proposed at the outset. The testimony presented shows that in the Spain of 1898 to 1923 a true picaresque attitude does not exist. An examination of the general national situation shows that the factor called "extreme poverty" was in existence, but the factor "authoritarianism of Church and State" was not present in an intense degree. In the second epoch (1923-1939) neither factor in the hypothesis was particularly strong; and as the study of the novels discussed indicates, the true picaresque attitude was also lacking in the literature of these years. The analysis of the novels in the third period (1939-1959) shows that, from a psychological point of view, there is a true picaresque literature; and the evidence accumulated shows that both of the indispensable factors are present in a high degree of intensity.

The general conclusion is that picaresque literature continues to appear in Spain because of being especially suitable for the interpretation of a certain kind of socio-economic oppressiveness, which is clearly present in the "Golden Age" of picaresque literature and in the present generation. The picaresque novel is both a realistic psychological manifestation and a subtle protest. The quality of humor and the general philosophical outlook are quite different in the novel of the 17th century and the novel of today, but basic elements of picarismo are common to both.

Microfilm $2.60; Xerox $9.00. 197 pages.

SIR JOHN CHEKE'S THE HURT OF SEDITION: A CRITICAL EDITION. (VOLUMES I AND II).

(L. C. Card No. Mic 59-5867)

Joan Eileen Mueller, Ph.D.
The Ohio State University, 1959

The present edition of The hurt of sedition howe greueous it is to a Commune welth makes available for the first time a definitive critical edition of Sir John Cheke's only English prose work. No edition of any sort has appeared since 1808, when Cheke's treatise was reprinted in the last edition of Holinshed's Chronicles, and none of the extant texts provides an uncorrupted or established text. The present edition, which utilizes previously unknown and undescribed material, provides the necessary authoritative text, together with introduction, explanatory notes, variants, and bibliographical descriptions.

This new edition of The hurt of sedition is based upon an hitherto unidentified and undescribed edition, the second of two 1549 editions of the treatise and the last one to be printed during Cheke's lifetime. The second edition is distinguished by an addition of two leaves comprising elaborative material which until now has been known only as a significant and unexplained variant in the first posthumous edition, the edition of 1569. The unique copy of the newly identified second edition of 1549 is located in the Folger Shakespeare Library.

The introduction to this edition includes a detailed discussion of The hurt of sedition, as well as a life of Cheke, which traces the academic, literary, political, and religious involvements of this influential humanist, teacher and friend of such men as Roger Ascham and William Cecil Lord Burghley, and tutor to Edward VI. The discussion of the treatise is focused upon an elaborated rhetorical analysis; historical occasion, authorship, doctrinal background, reputation and influence are additionally examined.

The Ket rebellion of 1549 provoked Cheke to write, on behalf of the crown, this vernacular treatise which, in addition to the humanistic thought it expresses, reflects sixteenth-century attitudes toward order and rebellion. In it Cheke argues from two fundamental positions-- that rebellion is unlawful and that it is harmful. In addressing himself to his first point he employs the traditional argument that both the unwritten and written laws of God prohibit rebellion. In his second and more fully developed position, Cheke does not follow in a well-defined tradition, but departs from the dominant practice of keeping strictly to arguments from authority and argues rather from utility. He attempts to accomplish his argumentative purpose by means of ideas and persuasive devices presented in the traditional rhetorical form of a deliberative oration specifically concerned with the inexpediency of the policy pursued by the rebelling commoners. As in all orations of this type, it deals with future consequences as shown by past experience. Following Aristotle's design of the classical oration as it is set out in the Rhetoric, Cheke skillfully employs logical, pathetic, ethical, and non-artistic proofs in a prose style which combines colloquial vigor with the formal dignity of the periodic sentence, characteristics which Cheke admired in the orations of Demosthenes, his practical teacher. For these reasons Cheke's treatise was admired by subsequent Renaissance critics such as Gabriel Harvey and Ben Jonson. Six Tudor and Stuart

editions, especially that included in the popular Holinshed Chronicles (1587), further indicate its importance to the period. The influence of Cheke's method and style are most significantly reflected in the Elizabethan "Homily Against Disobedience and Wilful Rebellion" of 1570 (included in the Second Book of Homilies of 1571) in which Cheke's substance and rhetoric are echoed. Because of the incalculable effect of the homilies upon the intellectual climate that nourished Spenser and Shakespeare, Cheke's influence upon such writers, although indirect, was pervasive. Microfilm $5.40; Xerox $19.00. 423 pages.

JEHAN DE LANSON, CHANSON DE GESTE OF THE XIIIth CENTURY, EDITED AFTER THE MANUSCRIPTS OF PARIS AND BERN WITH INTRODUCTION, VARIANTS, NOTES, TABLE OF PROPER NAMES, AND GLOSSARY.

(L. C. Card No. Mic 59-5569)

John Vernon Myers, Ph.D.
The University of North Carolina, 1959

Supervisor: Urban Tigner Holmes, Jr.

INTRODUCTION

I. CLASSIFICATION, HISTORICAL BASIS, AUTHOR, AND DATE

Classification--geste du roi. Historical basis--expeditions of Charlemagne and his sons into Italy. Author--unknown. Date--first third of the 13th century.

II. POPULARITY AND LITERARY VALUE

Popularity--unknown outside the French language area of Europe, but versions exist from the 13th, 14th, and 15th centuries. Literary value--almost perfect unity of action, considerable humor, and restraint in the use of the supernatural.

III. THE SOURCES OF JEHAN DE LANSON

Fierabras, Aspremont, and the lost Chanson de Basin. The difficulty of determining whether our poem drew on Renaud or vice versa is discussed.

IV. WHO WAS BASIN?

A summary of the scholarly literature on Basin, its versions in foreign languages, and its vestiges in Old French literature is given. It is determined that "de Genevois" was borrowed from Fierabras.

V. WHERE IS GENNES?

It is demonstrated from the internal evidence of the MSS that Basin held the area around Gennes (Maine-et-Loire), in France, rather than Genoa, Italy, as is usually supposed.

VI. WHERE IS LANSON?

The various suggestions as to the answer to this question are reviewed, and the theory of Louis Michel that the original MS laid the scene of the poem in the Midi is refuted. Considerable evidence is presented to show that Lanson is the Lanciano (Chieti), Italy, first suggested by Paulin Paris in the HLF, XXII (Paris, 1852).

VII. DESCRIPTION OF MANUSCRIPTS

The seven MSS of Jehan de Lanson are described, both the three that present versions of the original story and those of the greatly altered versions of Jean d'Outremeuse.

VIII. CLASSIFICATION OF MANUSCRIPTS

The MSS are classified and arranged in a schema. Argument is presented that C, the MS containing the 15th century version, could not have been written before 1456.

IX. LANGUAGE OF THE MANUSCRIPTS

The language of the three principal MSS is analyzed according to orthography, phonology, and morphology, and the dialectal influences are determined.

X. VERSIFICATION AND TABLE OF RIMES

XI. ANALYSIS OF THE POEM

XII. HOW THE TEXT WAS PREPARED

TEXT, VARIANTS, NOTES, TABLE OF PROPER NAMES, GLOSSARY, LIST OF WORKS CITED.
Microfilm $4.75; Xerox $15.80. 369 pages.

TWENTIETH-CENTURY CRITICISM OF FORM IN TRISTRAM SHANDY

(L. C. Card No. Mic 59-6167)

Charles Parish, Ph.D.
The University of New Mexico, 1959

At the time of its publication most critics dismissed the notion that there was a meaningful plan to Tristram Shandy. Sterne did not insist on this matter; there is only the book itself with its statements about purpose, method, and form. His contemporaries, preoccupied alternately with its "pathos" and with what they considered its indecencies, held it to be haphazard, any form it had being governed by the vagaries of the author. During the eighteenth century the book was examined only part by part, for it was not thought to be a seriously coherent work. Any confusion which arose from the complexity of the book was due, it was felt, to the author's lack of control or lack of motive. It was, in the words of one of Sterne's contemporaries, "a riddle, without an object.

The critics of the nineteenth century, although they also frequently addressed themselves to the character of the author, to the sentiment and pathos of Tristram Shandy, and to its indecency, began to consider larger elements of the novel. Sterne's methods of character construction and his presentation of dramatic relationship began to be seen as dependent upon the peculiar form of his novel. Coleridge even suggested that the digressions constituted the very form of it. His idea did not, however, stimulate

other critics of the century: their orientation is represented by Bagehot's comment that one of the great faults of the novel is its "fantastic disorder of form."

These attitudes toward the structure of the novel can be found in the twentieth century as well; the interpretation of form on the basis of what is known about Sterne's life and tastes is the primary example. But there has emerged--especially during the last thirty years--a series of new views which encourage a very different evaluation of the form of the novel. These views are based chiefly upon the recognition of the following: (1) the role of Lockean psychology in the novel, (2) the relationship between Sterne and Tristram, and (3) the relationship between narrative and "digression."

The understanding of the role of Lockean psychology in Tristram Shandy has led to a view of coherence which is peculiar to this century. The material of the novel is seen to be relevant to the experience of Tristram, whose organizing consciousness shapes the material of his history into the book he is writing. This character, Tristram, may be seen as independent of his creator, Sterne, according to the critics. And when the material once called "digressive" is interpreted as a function of the consciousness of Tristram and is seen as a characteristic of the mind of Tristram, then the true form of the novel can be seen.

Many critics of this century have contributed to an overall view of form in the novel. None has pushed his conclusions to their logical end. The purpose of my study has been to make a total integration of the three elements which have been the concern of the critics; the logic of that total integration has been tied constantly to the statements of the critics, and my aim has been to construct a theory of form which is defensible on the basis of the criticism of this century.

The contention of this thesis is that there is no dichotomy in the novel between what it says and how it says it. The form of Tristram Shandy takes its meaning, receives its justification from the character Tristram, just as Tristram becomes finally and completely understood and identified not from the events of his life but from the book whose very structure reflects his mind and his character.

Microfilm $4.60; Xerox $15.40. 358 pages.

THE DEVELOPMENT OF THE RHETORICAL DEATH LAMENT FROM THE LATE MIDDLE AGES TO MARLOWE

(L. C. Card No. Mic 59-5578)

Velma E. Bourgeois Richmond, Ph.D.
The University of North Carolina, 1959

Supervisor: Ernest W. Talbert

Chapter I is concerned with some generalities pertinent to the present study. Particularly in medieval vernacular narrative and in Tudor narrative do scenes of lamentation for the dead sometimes develop the subleties of relations between characters and expound their views of their situations. Since there has been no study of the rhetorical death lament in early English narrative literature, and since the existence of such a convention might support, in part at least, those critics who object to an emphasis upon "Senecanism" in discussions of the development of early English tragedy, the present study is concerned with analyzing the development of the rhetorical death lament from the late Middle Ages to Marlowe.

The lament for the dead is justified as a minor literary form in Chapter II. Specific evidence of the genre is found in Geoffrey de Vinsauf's lament for Richard I and in the fact that writers of medieval romance sometimes represent the bereaved as knowing that he is following an established tradition. Rhetorical treatises and manuals confirm the existence of such a tradition. Cicero, Geoffrey, the Ad Herrenium, Wilson, Puttenham, Apthonius, and Rainolde, are cited as evidence that rhetorical death laments were regarded seriously; and these rhetoricians' suggested principles of composition are explained.

The next two chapters discuss laments in narrative. Chapter III deals with those in "medieval" narrative (to 1535) with emphasis upon romances and chronicles. Chapter IV considers laments in Tudor narrative (1600), including chronicles, mirrors for magistrates, novelle as represented by Painter, Pettie, and Fenton, and romances like those of Sidney, Spenser, and Greene. There is a marked continuity of ideas and expression, as well as occasional new themes. Most significant is the constant attempt to develop the dramatic potentiality in laments within narratives.

Rhetorical death laments in plays are discussed in two final chapters. Chapter V briefly considers significant changes made by Elizabethans when they translated Seneca's dramas and shows the limitations of Seneca's use of the form. The chapter is, however, devoted mainly to analyses of laments for the dead in Elizabethan plays, including interludes, early 'classical' tragedies, several anonymous early plays, a few chronicle plays, and those of Greene, Peele, Kyd, and Marlowe. It appears that early Elizabethan dramatists, borrowing many of the techniques found in narrative, used a conventional form in the death scenes essential for tragedy.

The final chapter summarizes the findings and stresses certain generalizations about the development of the rhetorical death lament from the late Middle Ages to Marlowe and about its transfer from narrative to drama. Shakespeare's early use of laments is mentioned to show the deep penetration of the form into Elizabethan literature. Thus a significant explanation of the death scenes in early Elizabethan tragedy may well lie in the presence of effective, imitable scenes of lamentation in medieval and Tudor narrative. The passages of lamentation considered are then collected in an appendix.

Microfilm $4.70; Xerox $15.80. 367 pages.

BASIC ELEMENTS IN THE CRITICISM OF EZRA POUND

(L. C. Card No. Mic 59-6107)

Hershel Dale Rowe, Ph.D.
The University of Florida, 1959

What sort of critic is Ezra Pound? Asseveration presuming to answer this question is not difficult to find, and yet, despite sharply conflicting judgments as to its value, his criticism has been accorded little close analysis.

The present study is an attempt to minimize this lack, considering in detail the basic elements of his criticism under the following headings: (a) the proper function of criticism: amelioration; (b) methods: criticism by anthology; (c) the writer, society and convention: the concept of precision; (d) literature as revelation and the concept of presentation; (e) poetry and prose: the concept of intensity; (f) literature and tradition: the concept of ambiguity. Both Pound's theory and practice of criticism have been examined and correlated with his poetic practice, and an attempt has been made to arrive at a general appraisal of his merit as a critic based upon this examination and correlation.

His criticism, though it has proved highly suggestive to many individuals, is of a very limited sort. He is primarily interested in what may be described as the production (as opposed to the consumption) of literature, and hence his criticism consists largely of particular and general advice to authors about this craft of writing and of praise for such work, past or present, as seems to him consistent with this advice. The advice embodies certain recurrent concepts or principles, as the framework of this study indicates, but these principles will seldom withstand close critical analysis in respect to either their own clarity or consistency or their supposed empirical or logical justifications. Pound was not an aesthetician or a philosophical critic but a craftsman, and his criticism, for all its influence and portentous air of authority, must be taken or left as a homiletic projection of his personal preferences. These preferences, as it happens, have been shared by many poets, critics, and students during this century; but this aspect of Pound's importance has not been considered in this dissertation, which has been limited to the analytical problem.

Microfilm $3.35; Xerox $11.40. 259 pages.

DANTE AND THE ENGLISH ROMANTICS

(L. C. Card No. Mic 59-4088)

John V. Saly, Ph.D.
Columbia University, 1959

The aim of this study is to examine the reactions of English romantic poets, mainly of Shelley and Byron, to the poetry and personality of Dante. The results of this examination suggest new possibilities of looking at the romantic poets.

After a short historical survey of the rise in Dante's reputation, five factors are considered which account for much of the attraction Dante exercised over the romantics. The five characteristic leitmotifs of romanticism: 1) to grasp the infinite in the finite, eternity in the moment; 2) to express the ennobling and transforming power of the "eternal feminine"; 3) to unite religion and philosophy; 4) to regard the artist as the creator of his own self-contained universe; and 5) to admire the strong, the colorful, the monumental in human characters, have all been discovered by romantic critics in Dante's work. In the third chapter consideration is given to those figures of the English romantic movement whose acquaintance with Dante was not sufficiently extensive to be treated at greater length. However, Coleridge, Leigh Hunt, Landor, and Keats are discussed in some detail.

The main body of the paper is concerned with Shelley and Byron. Shelley rejected much of Dante: the picture of unalterable evil as depicted in the Inferno, Dante's theology, his Aristotelianism, his practical moral intention developed throughout the Comedy, and the perfect symmetry of the poem. Dante's style and imagery have, on the other hand, deeply influenced Shelley and so has Dante's way of seeing a spiritual reality behind the appearances of the material world. Byron translated passages of the Comedy and prefaced some of his poems with lines from Dante. There are some reminiscences of the Divine Comedy in Byron's poetry, mainly from the Inferno and from the first part of the Purgatorio. But Byron was more interested in Dante's life than in his work. The Prophecy of Dante has little to do with the real Dante, but gives a portrait modelled on the Byronic hero.

The keynote of the Vita Nuova and of the Comedy is humility. The main difference between Dante and the romantics was that they wanted to make man godlike by the removal of restrictions, whereas Dante thought that man can only become like God through denying himself. Dante was concerned with the earthly happiness of man and with temporal justice. In the De Monarchia and the Comedy he speaks at times like a prophet of Utopia. This concern was in some respects similar to the utopian speculations of Shelley and even to Byron's liberalism.

Microfilm $3.80; Xerox $12.80. 294 pages.

THE FRENCH SWAN-KNIGHT LEGEND

(L. C. Card No. Mic 59-5581)

Robert Lewis Schurfranz, Ph.D.
The University of North Carolina, 1959

Supervisor: U. T. Holmes

The three Old French poems which constitute the swan-knight cycle were attached to the beginning of the Crusade cycle in the late twelfth century. They were reworked and considerably enlarged in the thirteenth and fourteenth centuries.

This study of the cycle was based on four manuscripts (Bibliothèque Nationale MSS. 786, 1621, 12558, and Bibliothèque de l'Arsenal MS. 3139), and the Spanish version contained in the Gran Conquista de Ultramar.

The nucleus of the cycle is the Chevalier au Cygne. It is joined to the first poem of the Crusade cycle by the Enfances de Godefroi, which relates the youth of Godefrey of Bouillon, a descendant of the swan-knight.

The third poem in the cycle, the Enfants-Cygnes, treats the birth and childhood of the swan-knight. It is the only one of the three to exist separately from the cycle. The Enfants-Cygnes is a version of the swan-maiden legend which originally was in no way related to the swan-knight story. It survives in four distinct forms, two in French (Béatrix and Elioxe), one in Spanish (Isomberta), and one in the Latin Dolopathos. The legend was first attached to the cycle in the Elioxe version. Finding this unsuitable, a later redactor composed the Béatrix, which is a re-working of the Dolopathos swan-maiden story.

The swan-knight legend was first inserted into the genealogy of Godefrey of Bouillon in the second half of the twelfth century. There are no historical events in the history of either the House of Boulogne or the House of Lorraine which account for this myth. If such a circumstance did exist, it must have been before Godefrey's ancestors came to the ducal throne of Lorraine. Certain events related in the poems may definitely be traced back to the history of the duchy in the eleventh and twelfth centuries. In this period a majority of the dukes were named Godefrey. Two even bore the same epithet, le Barbu. The chroniclers easily confused these two men. This confusion, and the consequent uncertainty about the genealogy of the family, encouraged the poets to attempt to supply a fabulous ancestry to Godefrey of Bouillon. An anonymous poet first added the legend of the swan-knight. This was connected to the Crusade cycle by the Enfances de Godefroi. Shortly thereafter an entirely unrelated legend was joined to the cycle, the Enfants-Cygnes.

The swan-knight legend spread to the neighboring Houses of Cleves and Guelders in the thirteenth century when they were connected by marriage to the descendants of Godefrey of Bouillon.

Microfilm $2.50; Xerox $8.20. 179 pages.

COSMOPOLITAN ATTITUDES IN THE WORKS OF EMILIA PARDO BAZÁN

(L. C. Card No. Mic 59-6171)

Elizabeth Louise Scone, Ph.D.
The University of New Mexico, 1959

Of the nineteenth-century Spanish novelists, Pardo Bazán was the most gifted and lucid exponent of European culture. Her books on French naturalism helped make possible the engrafting of new techniques on the old patterns of Spanish realism. Her lectures at the Ateneo on the novel and revolution in Russia introduced a new literary focus to the Spanish public.

But Pardo Bazán's cosmopolitanism is still widely misunderstood. She is accused of dilettantism and superficiality in her interpretation of other cultures. The present study is an attempt to demonstrate that the cosmopolitan orientation is as integral a part of her work as her understanding of the regionalist spirit. The thesis considers the controversies which dogged her career as an apologist for European culture: (1) the argument over the value of regionalism with Pereda, (2) the polemics with the traditionalist strongholds of Carlist and military opinion, (3) the defense of naturalism. The remainder of the thesis is given over to an analysis of the impact of her travels and foreign readings on her thinking.

The conclusions reached are as follows: (1) Pardo Bazán rejected the extreme regionalist and provincial approach to literature; (2) Pardo Bazán, with an understanding of both conservative and liberal Spain, remained a moderate and a realist, even while advocating an intellectual awakening and a more courageous Spanish confrontation of the modern world. Consequently, her work serves to emphasize the possibility of a bridge between the "two Spains." In her books Spain looks out over the Pyrenees without surrendering its own resolute individuality.

Microfilm $2.50; Xerox $8.20. 180 pages.

ROBERT JOHNSON'S ESSAIES, OR RATHER IMPERFECT OFFERS (1601): A CRITICAL EDITION.

(L. C. Card No. Mic 59-4840)

Anthony Wimberly Shipps, Ph.D.
Northwestern University, 1959

Adviser: Professor Virgil B. Heltzel

The dissertation consists of an introduction, the text of the essays, and commentary. The text of Johnson's Essaies is based on the Huntington Library copy of the edition of 1601; it does employ a few readings taken from later versions. Textual notes show the result of collation of the editions of 1601, 1607, 1613, and 1638. The present edition is demonstrably superior to the edition now generally available, a facsimile reproduction of the 1607 edition.

The introduction identifies the author, presents some biographical details, establishes the Johnson canon and suggests some possible additions to it, and discusses the Johnson works, the essays in particular. The introduction demonstrates by passages common to the two works that the Robert Johnson who wrote the Essaies was the Robert Johnson whose translation of Botero's Relationi Universali appeared in several editions, beginning with The Travellers Breviat or The Worlde in 1601; it shows also that essayist Robert Johnson was R. I., the Virginia Company propagandist who wrote Nova Britannia (1609) and The New Life of Virginea (1612). To this now definitely established canon are suggested three possible additions: A Profitable and Necessarie Discourse for the Meeting with the Bad Garbelling of Spices (1591), Sir Thomas Smithes Voiage and Entertainment in Rushia (1605), and A True Declaration of the Estate of the Colonie in Virginia (1610). Several reasons, including a contemporary reference to a certain Robert Johnson in which he is described as the author of several treatises on Virginia, are advanced which very strongly indicate that the essayist was the Robert Johnson who served as Deputy Treasurer of the Virginia Company, a London merchant and alderman who was a prominent member of several trading companies until his death in 1626.

In the discussion of the Essaies the writer demonstrates a significant fact about the essayist's method of composition. The essays are shown to consist largely of quotations from several sources: Sidney's Arcadia, Sidney's Defence of Poesie, Bacon's Essays, North's Plutarch, the Basilikon Doron of King James, Fenton's The Historie of Guicciardini, Ascham's The Scholemaster, Bedingfield's The Florentine Historie of Machiavelli, Greneway's Annales of Tacitus, Savile's Histories and Agricola of Tacitus, and Du Vair's The Moral Philosophie of the Stoicks. Also, the sources of Johnson's Latin and Italian quotations are discussed briefly. Johnson's use of material which he borrowed is studied, and essay passages are shown to be made up of quotations joined together. In addition, the study of the essays reveals structural characteristics and habits of style. Some attempt is made to show additional relationships between the Essaies and other literature of the period, and the essays are assessed as essays.

A third major division of the dissertation, the commentary, consists mainly of passages as they appeared in the sources which Johnson used. Approximately one-third of the content of the essays is here shown to be taken almost verbatim from the works named above and from Latin writers. Latin and Italian quotations are identified and

translated. Classical or historical allusions are explained, and words are defined. Significant parallels in Johnson's works other than the essays are given.

The dissertation, then, provides the text of the essays, the identification of their author and a partial biography, the determination of the Johnson canon, and significant facts concerning the composition and style of the essays. What this edition demonstrates about the composition of the essays of one early essayist adds support to the frequently stated view that the essay evolved from the commonplace book.

Microfilm $4.10; Xerox $13.80. 320 pages.

FAULKNER IN HOLLYWOOD: A STUDY OF HIS CAREER AS A SCENARIST.

(L. C. Card No. Mic 59-6172)

George R. Sidney, Ph.D.
The University of New Mexico, 1959

Faulkner's career as a Hollywood screen writer has often been referred to by critics, but has never been thoroughly studied. His work in Hollywood is important biographically, for the money he earned as a scenarist enabled him to evade the economic necessity of writing for a commercial market. It is also important critically. As a scenarist, Faulkner, using his novelistic techniques, attempted to create in an alien medium. Thus his screen writings constitute a legitimate part of the Faulkner canon.

Not only was the medium alien, but the structure of the motion picture industry, during Faulkner's affiliation with it, was such that art and the artist were subordinated to business and the profit motive. The screen writer was deprived of control over his medium, denied valid material with which to work, and reduced to the status of an insignificant tooled part in an assembly line process.

Within this system, Faulkner worked for three Hollywood studios and wrote, or collaborated in the writing of, thirty-four screenplays and treatments: nine for Metro-Goldwyn-Mayer (May, 1932 - May, 1933), seven for Twentieth Century-Fox (November, 1935 - August, 1937), seventeen for Warner Brothers (July, 1942 - September, 1945), and one for the independent producer, Howard Hawks, in 1955.

For the purposes of this study, Faulkner's screen writings have been analyzed in terms of the manner in which he handled the elements of theme, character, action, and dialogue. His treatment of these elements was sometimes in the Hollywood tradition, sometimes in the Faulkner tradition, and sometimes neither preponderantly in one or the other, but rather "composite." The screenplays for which he received screen credit (Today We Live, Road to Glory, Slave Ship, To Have and Have Not, The Big Sleep, and Land of the Pharaohs) do not admit of such analysis, since they were collaborations. They do, however, indicate further the kind of work Faulkner was engaged in.

Faulkner was at his poorest when he accepted the expectations of his employers and wrote in the Hollywood tradition; his two best pieces of writing--War Birds and Country Lawyer--deal with his own characters and themes. Despite the cinematographic techniques that Faulkner uses in his novels, he was not a good screen writer. He could not create within the standardized form of the Hollywood screenplay and the artistically debilitating Hollywood system. He worked conscientiously, but uninspiredly. He looked upon screen writing as a remunerative avocation. His value for Hollywood was, and continues to be (as the recent screen adaptations of his novels indicate), his name. Microfilm $4.90; Xerox $16.40. 384 pages.

ELIZABETHAN SYMBOLISM AND THE UNITY OF TROILUS AND CRESSIDA

(L. C. Card No. Mic 59-5226)

Hal Hampson Smith, Ph.D.
Princeton University, 1958

In this dissertation I have tried to do two things: first, to investigate some important aspects of the symbolism of the Elizabethan stage; and second, to utilize Renaissance symbolism to illustrate the dramatic unity and theatrical effectiveness of Troilus and Cressida.

Chapter I is an investigation of what might be called the "style" of Elizabethan symbolism. There I discuss the parallel traditions of the emblem writers and the mythographers and the importance of these two aspects of Renaissance symbolism for the development of the concept of allegorical meaning. In Chapter II, these symbolic devices and techniques are observed as they work in the Shakespearean theatre. A scene from Coriolanus is taken as a typical instance of an emblematic stage picture, and two scenes from Lear are discussed as examples of the symbolic use of properties. The wrestling match in As You Like It is used to illustrate the actualization of mythological imagery in the theatre.

Chapter III is devoted to the discussion of some pre-critical problems of Troilus. There I have presented arguments against the idea that Troilus was written for an Inns of Court audience. Discussion of the text and genre of the play is followed by an examination of evidence for the use of classical costume in the Elizabethan theatre, the evidence suggesting strongly that plays such as Troilus were performed in classical costume as the Renaissance knew it. Chapter IV is concerned with certain aspects of the mythology of Troy as they were familiar to the Renaissance, and there I indicate the relevance of these mythological traditions to an interpretation of Troilus and Cressida.

My critical discussion of Troilus is concentrated on the two areas in which the dramatic and theatrical unity of the play has been previously denied. In Chapter V, I examine the long speeches of Ulysses on degree and time, concluding not only that the two speeches are connected metaphorically and thematically, but that the metaphors Ulysses uses are the thematic metaphors of the play, both linguistically and in concrete theatrical actuality. In Chapter VI, I discuss the "two plots" of love and war. By an examination of classical, medieval and Renaissance sources, I conclude that the two plots are unified through metaphorical analogy. In metaphorical tradition, Troilus' kind of love was frequently seen as war, and Shakespeare has balanced the metaphor of love as war with the complimentary metaphor of war as love.

Chapter VII is concerned with the mythology and the

staging of the play. There I demonstrate the thematic relevance of Shakespeare's mythological allusions in Troilus by reference to medieval and Renaissance mythographers, and I show, by an analysis of some of the staging demands of the play, that the mythological motifs and allusions are frequently actualized in stage groupings which refer to the visual traditions of mythology.

Microfilm $4.80; Xerox $16.00. 375 pages.

COLUMBUS, OHIO, THEATRE, SEASONS 1840-41 TO 1860-61. (VOLUMES I AND II.).

(L. C. Card No. Mic 59-6611)

Kathryn Elizabeth Utz, Ph.D.
The Ohio State University, 1952

To ascertain the cultural level of a part of what was called the West in mid-nineteenth century America, I selected Columbus, Ohio, the political and geographical center of the state, as a type of inland frontier town and made a survey of the plays, players, and playhouses of the Capital City for twenty-one seasons preceding the Civil War, or from 1840-41 to 1860-61.

The study was based on old Columbus newspaper advertisements and drama reviews, court house records, city directories, annals of various theatres, individual and collective stage biographies, theatre and drama histories, maps, photographs, city and state laws, and old plays, including many from a holding of over 1,100 in pamphlet form in the Ohio State University Library.

Information from various sources shows that Columbus grew from 700 people in 1815 to 31,274 in 1870, and from 1840 to 1850 was a close rival of Dayton and Cleveland for second place in the state, Cincinnati holding first place. The cholera epidemic in the summer of 1849 caused as many as 3,000 people, it was said, to leave Columbus. The town's inhabitants in the 1800's originated in New England, Virginia, Pennsylvania, Kentucky, Ireland, England, Wales, Africa, and, around 1852, about one third in Germany. Statistics on the occupations of Columbus males over fifteen years of age in 1852 show a preponderance of mechanics and laborers. Assessors' returns indicate Columbus was well off financially. However, the effects of the panic of 1837 lasted in the West up through 1845. Times were hard in 1854. The panic of 1857 also hit Columbus during the winter and next spring. All appear to have affected theatre-going.

Its central location made Columbus accessible by Neil and Moore stagecoach on the National Road; by water on an eleven-mile feeder from the Ohio "Canawl" that passed through Lockbourne; by railroad, in the fifties, on the C. C. C. and N. Y. from Cincinnati to Cleveland. A great many dramatic troupes came to Columbus from Dayton enroute to Zanesville. Others came from Cleveland or Cincinnati.

There was a mild flurry in the 1840's about locating the Ohio capital elsewhere, but from 1816 on, Columbus continued to be the political center of the state. While the state legislature was in session each year from early December to the following February or March there was usually dramatic entertainment of some kind in the Capital City, together with scientific and literary lectures, concerts, minstrel shows, church fairs, and balls. Many state legislators from different parts of Ohio were theatre-goers, so that the influence of drama in Columbus was probably more state-wide than that of any other city in Ohio. The Ohio State Journal and the Ohio Statesman, both published in Columbus, were state organs of the Whig and Democratic parties, respectively, and rival editors sometimes used lines and titles or mock scenes from plays to satirize each other. Until the Civil War actors themselves seemed to be non-partisan, but often newspaper support of the theatre followed party lines according to the political affiliations of the owners of the buildings used for plays.

Among the theatrical customs of the mid-nineteenth century were the double, triple, and even quadruple bills; the great variety of names for dramatic types (e.g., extravaganza, Protean piece, spectacle, and melo-drama and vaudeville, both musical pieces); the ending of farces with appeals to the audience for applause; the use of the green baize carpet for tragedy; musical, rhetorical, and terpsichorean entertainment between pieces; the use of double titles for plays and of new titles for old plays; "pirating" by gallery shorthand or sheer memory; the repertory system by which a different bill was offered nightly; general and complimentary benefits for stars; postponements for "indisposition" (illness), "circumstances over which the management had no control" (drunkenness), and non-arrival of stars because of transportation difficulties or inducements to stay a day or two longer for a previous engagement; and the "puffing" system in criticism, whereby newspaper people were deadheaded in exchange for complimentary notices. During this period, too, occurred a change in theatre architecture whereby the pit became the more elite parquette, and bars disappeared from the rear sections of the playhouses.

Buildings in which theatrical performances were given in Columbus between 1840 and 1861 include the first Columbus Theatre on In Lot 278 on the west side of North High Street near Gay, in use until late 1842 and then in the spring of 1843 converted into the City Hall; Neil's Building on High Street between State and Broad, one door south of the Neil House, in use in 1847-48 and, after a fire, converted into the Odeon Hall which was used off and on from the spring of 1851 to November, 1861, when it burnt and was once more rebuilt; Concert Hall in the Statesman Building over the Post Office on the southwest corner of State Street and Centre or Pearl Alley, nearly opposite the State House, in use from 1848 to 1850; Neil's New Hall, on High Street between Broad and State, the next building north of the Neil House, used from 1850 to 1853; Kinney's Mammoth Museum, a large tent erected at the corner of Broad and Seventh (Grant) during State Fair week in the fall of 1851; Walcutt's Museum on "High Street, corner of Town," in use in 1852-53, and Walcutt's Hall on "Town Street, near High," in use in 1853-54, which may have been the same building; Ambos' Hall on High Street, between State and Broad, the next door south of Neil's Odeon, in use from the summer of 1853 to the summer of 1855; City Hall over the Market House on Fourth Street between Town and Rich, used for Uncle Tom's Cabin in the spring of 1854; Carpenter's Hall, probably on the south side of Town Street, between Third and Fourth, used in 1857-58 for German theatre; Thalia Hall in Platt's Building on State Street, used for German and English productions around 1858-59; Kannemacher's Building, on High Street, between Rich and Friend (Main), in use from 1860 or 1861 on; and the Dramatic Temple, later called Columbus Theater, on In Lot 441 on East State Street where the Grand Theatre now

stands, used from September, 1855, on, except during the Lincoln campaign when it was Republican headquarters. There were also numerous pavilions or tents used for plays, particularly for those put on by dramatic corps attached to circuses and menageries.

People in the 1800's had various attitudes towards the theatre. Political bias has already been mentioned. Many people held that the theatre injured public morals and hence should be taxed so as to make at least partial restitution for the damage it did the young in particular. Columbus, like other cities, required licenses for theatres, circuses, musicians, and lecturers. City ordinances in effect from 1840 to 1870 indicate the usual fee was twenty dollars for the first twenty-four hours and ten to twenty for the second twenty-four. Except for the period from 1846 to 1855, it was possible to secure a yearly license for $100.00. Public opinion caused fees to be lowered for scientific and musical entertainments. Statistics show the cash received by the mayor for license, shows, and fines was about 2 per cent of the total city income.

Many churches condemned the theatre. An 1849 Dayton conference of the Methodist Episcopal Church North advocated disciplinary action for members countenancing "dancing parties, theatrical and circus performances, and comical exhibitions." The Cross and Journal, a Baptist weekly published in Columbus, spoke against the stage. The protestant Episcopal rector in Columbus objected to the theatre, as did the Welsh Presbyterians and the Welsh Calvinistic Methodists. Some, at least, of the members of the German churches must have favored the stage, for there were German amateur dramatic societies in Columbus in the fifties or earlier. The language barrier probably kept both Welsh and German opinion from having much effect on the English theatre.

At the same time there was developing a feeling that some kind of amusement was necessary. A Columbus bookstore sold Frederick W. Sawyer's A Plea for Amusements in 1848. The same year Henry Ward Beecher spoke in favor of some kind of amusement, though not the theatre, of course. The Ohio State Journal in 1859 reported trouble a Unitarian congregation in Cincinnati had with a minister who insisted amusements were needful and even attended the theatre himself, committing the heinous crime of occupying the pit with the boatmen. Even in 1845 the Statesman felt too much emphasis was being put on the materialistic, the scientific, and the useful in the way of lectures. In the 1848-49 session of the legislature State Senator Whitman argued Ohioans were too grave a people, and an act to regulate public shows was amended.

Still, many people considered actors and actresses immoral folk, constantly involved in murders and divorces. The Journal lamented Mrs. Anna Cora Mowatt's choice of the stage as a career. It was also felt that those who came in contact with players would become immoral. A Statesman correspondent bemoaned the custom of employing as supernumeraries at the theatre young Columbus boys, who would successively develop a taste for the stage, the playhouse bar, the public coffee house, the gaming room, and the house of ill fame. There was a notion, too, that theatre people made great sums of money with little effort. The receipts of New York stars were published in the newspapers, but readers failed to realize these cases were the exception and many actors were often without employment and salary.

Another criticism of the theatre was the adaptation of European novels, especially "that detestable stuff, stitched in pink and yellow covers" by Eugene Sue, Balzac, Dumas, and George Sand. Bulwer, one of the most popular authors, also came in for censure. Perhaps to combat the feeling against authors thought to be licentious, advertisements seldom failed to mention the names of three playwrights: the Rev. John Home, the Rev. R. C. Maturin, and the Rev. Henry Hart Milman.

Some unprejudiced people did not attend the theatre very frequently because they felt the drama had degenerated.

Swearing and indecent remarks on the stage must have been fairly prevalent or managers would not have been continually advertising that nothing in their performances was "in the least degree demoralizing" or would in any way "offend the most sensitive mind."

Until the pit became the parquette, a saloon was a part of nearly every theatre. Despite city ordinances to the contrary, liquor was sold on the premises of the old Columbus Theatre on High near Gay and was said to have been the place's downfall. Actors now and then played in a semi-sober or wholly intoxicated state.

With a change of bill daily and two or three plays a night, some members of the company ruined otherwise good productions by forgetting their lines.

Gambling, too, was linked with the theatre. Sometimes prizes—toys, jewelry, dishes for the ladies, etc.—were given to lucky ticket-holders. The Dramatic Temple was built with funds from a $300,000.00 nation-wide lottery.

There were two cases of actual theft by theatrical people—one in 1853 and one in 1861—and in 1858 a manager left without paying his bills.

Part of the third tier in theatres had for years been literally reserved for prostitutes. Columbus managers time and again advertised that positively no improper persons would be admitted to any part of the auditorium, an indication that probably some were occasionally.

If not all who attended the theatre were vicious and dissipated, certainly many were ill-bred, annoying the "wealth, beauty, and respectability" of the town by their loud talking, swearing, and laughing, eating peanuts and apples and throwing the shells and peelings down on the heads of those below. So-called gentlemen sat with their hats on, spit tobacco juice, stamped their feet, and whistled and applauded at inopportune times during the play. Babies squalled. People rushed out when they saw the play was drawing to a close. Correspondents and newspaper reviewers alike deprecated all these things.

People did not complain for themselves that theatre tickets were too high, but many felt "the poor" should not spend their money for popular amusements. At 50¢ to $1.00 for a gentleman and two ladies, to 50¢ or 75¢ in the dress circle and parquette, 25¢ to 50¢ in the family circle, and 15¢ to 35¢ in the third balcony, a mechanic making $7.00 a week could hardly have been able to go to the theatre very often. In Columbus elite circles, according to William Dean Howells, it was not good to see plays too frequently.

Other factors keeping people from the theatre were poor audibility and visibility, especially before gas lights; inadequate heating during the cold winter nights; a lack of regular cleaning and painting of the public halls,; and the feeling, at least until the installation of gas lights in Columbus in 1850, that theatres were great fire hazards.

A study of the occupations of those whose names appeared in news papers as patrons at nine complimentary benefits between 1849 and 1861 revealed that friends of

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

the drama included numerous members of the state legislature, as well as the governor and other high state officials occasionally, the Columbus mayor, attorneys, a probate judge or two, editors, printers, book publishers, book store proprietors, bank employees, bookkeepers, livery stable keepers, iron manufacturers, grocers, clothing merchants, commission merchants, hotel proprietors, railroad and railway express agents, telegraph managers, jewelers, bowling saloon proprietors, druggists, physicians, and others. A number of these were people not living at home but at hotels and boarding houses. City directories, state legislature lists, etc., provided much of this information. Further evidence that editors and political men were familiar with the theatre comes from the use of dramatic allusions in the party newspapers.

Benefits were given for Columbus artillery or guard companies and the firemen, when members of those groups attended the theatre in uniform. Undoubtedly state and county fair visitors went to the theatre, too. In the spring of 1861 soldiers are mentioned as among the audiences.

How many people went to the theatre is hard to determine, for accounts vary from "twenty to thirty" to "crowded houses" for the same periods. Certainly there are many indications that attendance was not, as a general rule, high. At any rate, both regular theatre buildings failed financially.

A tally shows about 578 different plays were put on by about 747 different actors, musicians, and theatre attaches in the period between the fall of 1841 and the spring of 1861. Because Christian names or even initials of players were often missing and the same plays were frequently given under different names, it is impossible to be exact.

Among the better known people who played in Columbus were J. B. Buckstone, Eloise Bridges, McKean Buchanan, Alf Burnett, Mr. and Mrs. W. H. Crisp, C. W. Couldock, Charlotte Crampton, William Pleater Davidge, Kate and Susan Denin, Sir William Don, Mrs. Alexander Drake, Miss Mary Duff, Catherine Wemyss Duffield, Mr. and Mrs. Edward Eddy, O. E. Durivage, Mr. and Mrs. John Ellsler, W. M. Foster, Harry Gossin, James Delmon Grace, Julia Dean Hayne, Matilda Heron, "Yankee" Hill, George W. Jamieson, "Yankee" Locke, Cornelius and Eliza Logan, Dan Marble, Adah Isaacs Menken, Maggie Mitchell, R. E. J. Miles, Mrs. Coleman Pope, Mr. and Mrs. Joseph Proctor, Peter and Caroline Richings, Sallie St. Clair, J. W. Wallack, Jr., Jack Winans, and Charlotte Wyatt.

The following tables show the total number of plays by different periods:

By Years

1840-41	58	1845-46	0	1850-51	24	1855-56	195
1841-42	16	1846-47	5	1851-52	14	1856-57	137
1842-43	1	1847-48	51	1852-53	45	1857-58	114
1843-44	1	1848-49	53	1853-54	43	1858-59	75
1844-45	0	1849-50	14	1854-55	76	1859-60	9
						1860-61	144

By Five-Year Periods

	1840-41 to 1844-45	74
	1845-46 to 1849-50	105
	1850-51 to 1854-55	155
(Six Years)	1855-56 to 1860-61	425

By Decades

	1840-41 to 1849-50	160
(Eleven Years)	1850-51 to 1860-61	505

The following table lists the most frequently given plays for the entire period of the study, together with authors, and (in parentheses) the number of times given:

Twenty-one Years, 1840-41 to 1860-61, with Foremost Authors

Uncle Tom's Cabin (44) (George Aiken et. al. from H. B. Stowe)	20 plays
The Stranger (including 1 to 3 German) (25) (August Kotzebue, tr. by Thompson et. al.)	
Aladdin (2 versions?) (24) (John Ellsler et. al.)	
Lady of Lyons (24) (Lord Bulwer-Lytton)	
Loan of a Lover (20) (James Robinson Planché)	
Othello (20) (William Shakespeare)	
Honey Moon (17) (John Tobin)	
Perfection (17) (Thomas Haynes Bayly)	
Dead Shot (16) (John Baldwin Buckstone)	
Rough Diamond (16) (John Baldwin Buckstone)	
Pizarro; or, The Death of Rolla (15) (August Kotzebue, tr. by Thompson et. al.	
Swiss Cottage (15) (Thomas Haynes Bayly?)	
The Hunchback (14) (James Sheridan Knowles)	
Camille (13) (Matilda Heron et. al.)	
Damon and Pythias (13) (John Banim or Richard Lalor Sheil)	
Macbeth (13) (William Shakespeare)	
Mr. and Mrs. Peter White (13) (Richard John Raymond)	
Ingomar (not including 1 German) (12) (Tr. from German Halm by Maria Lovell)	
Irish Tutor (12) (Richard Butler, Earl of Glengall)	
Richard III (12) (William Shakespeare)	

Given eleven times	8
Given ten times	5
Given nine times	3
Given eight times	10
Given seven times	13
Given six times	24
Given five times	30
Given four times	32
Given thrice	67
Given twice	129
Given once	237
	578

The conclusion from the study is that there was a great deal of dramatic activity in the West of the 1840-60 period. Plays, players, and at least part of the time playhouses, were on a par with the Eastern cities.

Microfilm $11.40; Xerox $40.60. 901 pages.

Abstract published by special arrangement with The Ohio State University.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

MARIANNE MOORE: UNFALSIFYING SUN AND SOLID GILDED STAR.

(L. C. Card No. Mic 59-4673)

Francis W. Warlow, Ph.D.
University of Pennsylvania, 1959

Supervisors: Robert E. Spiller and
E. Sculley Bradley

Part I - Personae of the Person

To get at the poetic method of Marianne Moore, this study proceeds from her life to an analysis of her poetry. Out of biographical data, the comments of her contemporaries and her own verse and prose, certain dominating characteristics emerge.

For all her emphasis on concrete things and science, her primary orientation is spiritual. She is a religious person, the product of a family and national tradition of gentling Calvinism. Her Christianity represents the persisting best of American Puritanism but also acknowledges kindred values in other traditions. Her religion, so much taken for granted that it is hard to categorize, becomes overt in her morality.

Though generally undidactic and indirect, Miss Moore is a moralist whose poetry always "affirms" something: humility, solitude and community, responsiveness and responsibility, precise workmanship, hope, gratitude, love, triumph through surrender. These abstractions, mostly traditional individual and communal values, take on concreteness through discriminated particularities, often in a new kind of best fable.

She is also a rationalist-scientist. Curiosity spurs her to observation and thought. She is a meditative connoisseur, an intellectual humorist adept in whimsy, wit and irony, and a semi-scientist learned in biology. With precise scientific, historical and esthetic data, she thinks associatively toward spiritual and moral generalizations.

As an artist, she puts feeling first. She writes about the rare and common phenomena that move her to praise, that suggest comely or strict values, that challenge her to find connections and to express them fastidiously. Her poetry is a "hard trying" for the exact words, images, music and assymetric organic forms to epiphanize a felt wisdom. She is both a gentled Puritan or metaphysical and an esthete or subtle performer.

Part II - The Poet

Miss Moore's career from Bryn Mawr to the present provides the heart of the study. The emphasis is upon explications of representative poems from each of her "periods": 1) through Poems, 1921, 2) through The Dial, 1929, 3) through The Pangolin, 1936, and 4) to the present.

The conservative values of Part I are expressed freshly in all periods. Her verse and critics' reactions to it indicate a development from lyrical and epigrammatic miniatures to sustained commentaries which reflect a growing treasury of materials, a subtler and wider associativeness and a denser richer musicality. Her early tentativeness and preoccupation with the role of the artist and with artistic masters give way to enlarging confidence and virtuosity. Her early idiosyncratic forms expand to the exuberantly sustained free verse commentaries most characteristic of her second period, and these in the third mutate into long several-part poems which return to eccentric stanza units and in the fourth period shrink back to moderately long, still eccentrically formal poems, closely connected thematically and materially.

Part III - The Method

Miss Moore's distinctive literary qualities are linked to her reconciliation of the American metaphysical tradition and English Estheticism. Behind this are French influences, the whole of Anglo-American literature, its prose as well as poetry, and the classics. Among American modernists she is central along with Pound, Eliot, Stevens, Williams and Cummings.

Her problem has been to present her conventional values originally in the face of a levelling mass culture. Hence her method, combining individualism and classicism, exoticism and plainness, is her principal concern. It involves a passion for precise diction and images, a spontaneous idiom and rhythm, an unobtrusive but at times emphatic musicality, and a witty symbolizing associativeness - all interacting within and with eccentrically severe forms. Her motivation is a responsive responsibility which is ultimately religious.

Microfilm $5.65; Xerox $19.80. 442 pages.

THE DESCENT OF CHRIST INTO HELL: A STUDY IN OLD ENGLISH LITERATURE.

(L. C. Card No. Mic 59-6742)

W. D. White, Ph.D.
The University of Texas, 1959

Supervisor: Rudolph Willard

Part I of this study is devoted to the origin and history of the concept of the descent of Christ into hell, while Part II is given to an examination of the Old English literature, including poetry and prose, in which this theme plays a prominent role.

An examination of various ethnic mythologies shows that virtually every mythological system has some notion of the journey of a god or hero into the world of the dead. While the christian doctrine of the descent of Christ into hell shares many of the common features of this myth, it is nevertheless rooted in the distinctly Hebrew conceptions from which the christian faith sprang, as these were interpreted in the light of a belief in the resurrection of Jesus. The earliest christian notion simply asserts that at his death, Christ, like all other men, descended into the place of departed spirits.

New Testament literature makes frequent allusions to the Descensus, and the early fathers employ the tradition in apologetic and polemical writings. A vigorous literature and art grew up around the idea, culminating in the Gospel of Nicodemus, an apocryphon which exerted great influence on the art and thought of the christian world for many centuries. This version of the tradition centered in the triumphant descent of Christ into hell, for the purpose of rescuing the saints who there awaited his coming. While the tradition underwent reexamination in succeeding generations, and variant developments existed side by side, its normative imaginative expression remained the Gospel of Nicodemus, while its formal theological statement remained

the deceptively simple article of the received version of the Apostles Creed, "He descended into hell".

The Old English literature represents a bringing together of two very different cultural and poetic traditions, Latin christian and continental Germanic. The literature is in many cases sophisticated and self-conscious, showing a highly-articulate tradition. Much of the poetry, as well as the prose, was written by chruchmen, and it reflects their concern for bringing christian teachings into a vernacular artistic expression.

In the Old English religious poetry, the Descensus plays plays a prominent role. One short poem, the Exeter lyric Descent into Hell, deals primarily with this theme. The Cynewulfian poems Christ II and Elene, as well as the Junius manuscript Christ and Satan, give the theme special attention. The Descensus also finds a place in the anonymous poems Christ I, Christ III, Dream of the Rood, Physiologus, and Phoenix.

Old English prose likewise reveals the broad influence of the Descensus tradition. The Gospel of Nicodemus exists in a complete Old English translation, of which three versions are extant. The homiletic literature, particularly Blickling Homily VII and the CCCC Ms. 41 Easter Homily, gives extensive treatment to the theme. The prominence of the Descensus motif in Old English prose and poetry, and the way in which it is employed, show that the Gospel of Nicodemus assumed a position of authority just subcanonical. Microfilm $3.80; Xerox $12.80. 293 pages.

BLACKWOOD'S MAGAZINE: A SELECTIVE AND CRITICAL BIBLIOGRAPHY OF REVIEWS (WITH AN INTRODUCTORY ESSAY), 1850-1880.

(L. C. Card No. Mic 59-6647)

McDonald Williams, Ph.D.
The Ohio State University, 1954

The literary periodicals of the Victorian period were significant in that they both mirrored and influenced the thought of the time, yet as a group they have received considerably less study than the Victorian novel, poetry, and nonfictional prose. Although some work has been done on Blackwood's, it has been confined to various aspects of the period from 1817, when the magazine was founded, to 1854, the year of the death of John Wilson, who was the magazine's most important early contributor.

The purpose of this annotated bibliography of Blackwood's Magazine is to examine and evaluate literary reviews that appeared from 1850 to 1880, when John Blackwood was editor. The bibliography is broken down into three major divisions: nonfictional prose, novels, and poetry. Nonfictional prose is subdivided into (1) biography, (2) fine arts and aesthetics, (3) history, (4) philosophy, religion, science, and (5) politics, society, economics. Novels and poetry are classified under two headings: (1) general criticism and (2) individual authors. The writers included are the major and significant minor Victorians. The reviews under each subdivision of nonfictional prose and under general criticism of novels and poetry are arranged chronologically. Individual novelists and poets are listed alphabetically, but a chronological order is followed for articles dealing with a particular author.

Blackwood's does not review biography extensively, but it does handle well-known Victorian works of this genre in Newman's Apologia, Mill's Autobiography, and Trevelyan's Macaulay. Noticeable are (1) its critics' usual practice, which is characteristic of the Victorian reviewer, of telling a reader what a book is about by describing its contents at great length and by extracting long and numerous passages from it, and (2) its traditional penchant for abusiveness, which can be largely attributed here, as elsewhere in Victorian criticism, to anonymous reviewing. Blackwood's does not neglect the primary obligation of evaluation, but only its judgment of the Apologia is sound. Because it lacks "disinterestedness," it unjustly condemns, for one reason or another, Mill's Autobiography and Trevelyan's Macaulay.

More satisfactory than its treatment of biography is the magazine's coverage of works concerned with fine arts and aesthetics. Although it neglects to consider Ruskin's Stones of Venice, II and III (1853), Modern Painters, IV (1856) and V (1860), The Political Economy of Art (1857), and The Two Paths (1859), Blackwood's does, nevertheless, review a great deal of Ruskin's work throughout the '50's, and it discusses Pater's Renaissance (1873), his first and only book to appear in the '70's. Blackwood's judgment of Ruskin varies from being biased to being discriminating and honest, depending on the reviewer. Ill-considered estimates are made by John Eagles, W. E. Aytoun, and John Paget, who, for personal or other reasons, persistently defend the principles and theories of the Royal Academy against Ruskin's views in claiming Turner's later style to be superior to his earlier (which has since become established) and in championing the Pre-Raphaelites. William Smith and Joseph B. Atkinson, whose views anticipate those of modern criticism, are perceptive and open-minded. They call attention to Ruskin's shortcomings, such as his dogmatism, self-contradictions, and moral view of art, and indicate that his judgments often cannot be trusted. Both recognize his influence, however, and they agree that, whatever his faults, he has done good by revitalizing the criticism of art in England and by stirring the British layman to a consciousness of art.

In dealing with Ruskin, Blackwood's is militant and confident, but it is confused and bewildered by Pater's Renaissance. It recognizes in Pater a new and undesirable view of art and of life, and in condemning him, Blackwood's agrees with Elton, who finds that the great deficiency in Pater is "the want of fresh air."[1]

To deal adequately with history during the Victorian period, a reviewer would have had to have knowledge of the trend away from the literary and toward the scientific approach to history. At the time that volumes of Macaulay and Carlyle, the great popularizers of history, were being bought by the thousands, German and English scholars like Ranke (whom Macaulay did not esteem highly) and Stubbs, E. A. Freeman, and J. R. Green were at work. Mrs Oliphant and E. B. Hamley, who discuss Macaulay's History and Carlyle's Frederick the Great respectively, give no indication that they are acquainted with this change in attitude toward history. As a result, they are in no position to make a proper evaluation of Macaulay and Carlyle as historians. John Paget, on the other hand, demonstrates in his four articles on Macaulay's History that he is

thoroughly familiar with the new view. After he has pointed out many of Macaulay's errors, Paget predicts accurately that the time will eventually come when the History will be regarded as of little value as an authority.

That the Victorian period was an arena of conflicting ideas can be seen in Blackwood's coverage of works dealing with philosophy, religion, and science. In philosophy, the dispute is between the schools of empiricism and intuition, which are represented by Mill and Hamilton respectively. Realizing that the materialistic approach to man and reality is spiritually and ethically dissatisfying, Blackwood's takes sides with idealism and fights to repel Mill's influence. Its attack upon Mill is directed chiefly against his empirical ideas in Examination of Hamilton's Philosophy (1856).

More violent than the controversy between the two philosophical systems is that between religious orthodoxy and its opponents--scientific naturalism, Biblical criticism, and liberal theology. With its religious faith resting, as did that of the orthodox Victorian believer, upon the conviction that the Bible is infallible, Blackwood's combats any findings or views that contradict the Bible's authority. Mansel's The Limits of Religious Thought (1858), Darwin's Origin of Species (1859) and The Descent of Man (1871), Renan's Life of Jesus (1863), Huxley's Lay Sermons, Addresses, and Reviews (1870), and Tyndall's Fragments of Science for Unscientific People (1871) are all disparaged because they contain inferences that are unscriptural. Even Seeley's Lectures and Essays (1870) and Arnold's Literature and Dogma (1873), which represent the thinking of men who were genuine friends of an enlightened religion, are criticized primarily because Blackwood's resents seeing the Bible approached as though it were any other book. Such well-known works as Essays and Reviews (1860), Colenso's The Pentateuch and the Book of Joshua Critically Examined (1862), Lyell's Antiquity of Man (1863), Seeley's anonymously published Ecce Homo (1865), and Arnold's God and the Bible (1875) are not reviewed, but what Blackwood's attitude toward them would have been is evident.

This struggle was not an easy one because the claims of science, especially, were advanced by skilled controversialists like Huxley. Uneasy over these claims, Blackwood's welcomes, as in Hugh Miller's The Testimony of the Rocks (1857), any attempt to reconcile science with religion. But if no such agreement can be worked out, and it has to choose between the two, Blackwood's rejects science and selects religion. The choice lies, Blackwood's is convinced, between a stone and bread, and it prefers bread.

In its review of works concerned with politics, society, and economics, Blackwood's reflects the spirit and thinking that was dominant among the mid-Victorians. Its anti-intellectualism and adherence to the laissez-faire principles of the classical economists are exhibited in its complaints about Carlyle and Ruskin. According to Blackwood's, Carlyle's works, from Sartor Resartus (London, 1838) through Latter-Day Pamphlets (1850), and Ruskin's Time and Tide (1867) are to be condemned because they contain no practical remedies for the many ills that Carlyle and Ruskin are so adept at exposing, and they advance ideas that would increase governmental activity in the regulation of society.

Blackwood's further shows that its reactions may be classified as those that prevailed generally during the mid-Victorian period by being hostile to radical change and distrustful of theories and speculative thinking. Because he advocated the removal of women's political, social, and legal disabilities in speeches before Parliament and in The Subjection of Women (1869), Mill is severely attacked by Blackwood's, whose only real objection is nothing more than an unreasonable desire to see woman's status remain unchanged. In describing British aversion to change, Mill himself says: "It is the character of the British people, or at least of the higher and middle classes who pass muster for the British people, that to induce them to approve of any change, it is necessary that they should look upon it as a middle course: they think every proposal extreme and violent unless they hear of some other proposal going still farther, upon which their antipathy to extreme views may discharge itself."[2] Blackwood's rejection of Mill's program for land reform indicates that, in addition to fearing change, it is highly suspicious of ideas.

National self-satisfaction, another general trait of the mid-Victorians, is displayed in Blackwood's handling of Arnold's Friendship's Garland (1971) and Mixed Essays (1879). It views with great shock and regret charges such as those that Bottles is obtuse, that the British are not well thought of by people on the Continent, and that the English system of secondary education is vastly inferior to the French.

By judging Trollope's North America (1862) on purely political grounds, Blackwood's still mirrors characteristic British opinion, which favored the cause of the South in the American Civil War.

Since Blackwood's was so diligent in opposing the Victorian prophets, it is surprising that it overlooked such publications as Mill's Representative Government (1861), Ruskin's Unto This Last (1862), Carlyle's Shooting Niagara, and After? (1867) and Arnold's Culture and Anarchy (1869). If Blackwood's had reviewed them, however, one may assume that its anti-intellectualism, individualism, conservatism, and complacency would have determined its apparisal of these works.

From the standpoint of modern criticism, Blackwood's survey of the novel from 1850 to 1880 is largely unsatisfactory. Because its conception of the novel, like that of other Victorian critical organs generally, is that it is light literature that should tell an entertaining, edifying, and credible story about pleasant, respectable, and believable people, Blackwood's makes a number of judgments that would be regarded today as unbalanced. Further, it does not review the novel extensively. By viewing the novel as it does, Blackwood's misjudges Dickens, Thackeray, Charlotte Bronte, Charles Kingsley, Mrs. Gaskell, and Bulwer-lytton; and, while its general estimates of Blackmore, Collins, Disraeli, Lever, Reade, and Thomas Trollope are still valid, they are now established on either different or additional grounds. Its appraisals of Eliot and Mrs. Oliphant come closest to anticipating present critical thinking.

As popular as the novel was during the Victorian era, it is rather surprising that Blackwood's gives it no more space than it does. Usually, Blackwood's either reviews but one book by an author or waits for some occasion, such as the publication of a novel that becomes popular immediately, the appearance of an edition of his works, or his death, to comment on selected novels and evaluate his career. Eliot, with a separate article devoted to Adam Bede, The Mill on the Floss, Felix Holt, and Middlemarch, receives the most attention, while Dickens is noticed but

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

three times and Thackeray and Meredith but once each. Blackwood's weakness in this respect is most apparent, however, in its treatment of Trollope and Hardy. No article appears which deals exclusively with a novel or novels by Trollope, the chief references to him being in "Trollope's North America,"[3] in which E. B. Hamley mentions that Trollope is primarily a novelist, and in "Contemporary Literature: Novelists,"[4] in which A. Innes Shand groups Trollope with Eliot and Mrs. Oliphant as the leading novelists of the day. Hardy is not reviewed at all.

Blackwood's judgments of novelists, for the most part, would seem to justify Lounsbury's opinion that criticism by Victorians of their contemporaries is worthless.[5] The Victorian feeling that "a novel is a novel, as a pudding is a pudding, and that this was the end of it"[6] probably accounts for Blackwood's failure to review the novel more widely than it does, despite the fact that the novel had become the most popular form of literature.

Blackwood's treatment of poetry produced from 1850 to 1880 is inadequate because it misjudges most of what it does review, and it fails to consider many publications. Blackwood's, like so many other critical magazines and journals, takes pride in describing the times as unpoetical. Nonfictional prose and the novel, both of which are superior rivals, are considered more adaptable than poetry to the needs of a practical age. That poetry is being written, however, and must be reviewed, Blackwood's realizes.

The poor evaluations made by its critics, Mrs. Oliphant, W. Lucas Collins, Anne Mozley, and Elizabeth J. Hasell, are a result of their primary emphasis upon content and purpose. Only W. E. Aytoun and E. B. Hamley, who consider form, execution, and technique important, render judgments that approximate those of modern criticism.

No less serious than Blackwood's misjudgments is its failure to review many poetical works. Tennyson's In Memoriam (1850), while commented upon in various articles, was never reviewed as such. His The Holy Grail and Other Poems (1869); Browning's Christmas Eve and Easter Day (1850), Dramatis Personae (1864), and all of his work of the '70's except Aristophanes' Apology (1875); Arnold's Empedocles on Etna and Other Poems (1852), Poems: Second Series (1855), and New Poems (1867); and Morris's The Defense of Guenevere and Other Poems (1858) and all of his work after The Earthly Paradise (1870) went unnoticed. The work of Swinburne, Meredith, Christina Rossetti, Fitzgerald, and Patmore was completely neglected. Microfilm $2.50; Xerox $4.40. 81 pages.

1. Elton, Oliver. A Survey of English Literature: 1830-1880. London: Edward Arnold and Company [n.d.], I, 279.

2. Mill, John Stuart. Autobiography. New York: Henry Holt and Company, 1873, pp. 294-295.

3. Hamley, E. B. "Trollope's North America," Blackwood's Magazine, 92 (September, 1862), pp. 372-390.

4. Shand, A. Innes. "Contemporary Literature: Novelist," Blackwood's Magazine, 125 (March, 1879), pp. 322-344.

5. Lounsbury, Thomas R. The Life and Times of Tennyson: 1809-1850. New Haven: Yale University Press, 1915, Introduction.

6. Besant, Walter, and James, Henry. The Art of Fiction. Boston: DeWolfe, Fiske, and Company [n.d.], p. 52.

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CASANOVA'S PORTMANTEAU: A STUDY OF CAMINO REAL IN RELATION TO THE OTHER PLAYS AND STORIES OF TENNESSEE WILLIAMS, 1945-1955

(L. C. Card No. Mic 59-5690)

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Supervisor: Dr. Robert H. West

This dissertation addresses itself to the following questions: How does a twentieth-century writer, currently engaged in the processes of authorship, express himself to his audience? How are his efforts comparable to those of his predecessors? What combinations of characterization, situation, and action are reiterated in his plays and stories? What disparities exist between the writer's conception of his publications, as he believes he knows it, and the audience's response to his publications, as that response is recorded in letters and reviews?

Tennessee Williams' works have been selected because Mr. Williams, actively writing at this time, asserts his desire to share with other persons what he has to offer, thereby avowing his efforts to produce other than ars gratia artis; because one of his plays, Camino Real, has excited controversy concerning communication of meaning and interpretation of symbols; and because discussion of the similarities in his characterization, settings, and action may motivate the reader to consider further the implication of patterns in verbal representation of experience.

Materials consist of twenty-five plays and twenty-one stories published by Mr. Williams during the period 1945-1955 as well as pertinent observations printed in newspapers, periodicals, and books. The method of examination rests mainly upon identification of archetypes in the Williams canon. Chapter I summarizes Williams' defense of Camino Real; reviews evidence of controversial reception accorded the Broadway production; discusses possible causes of this reception; examined Williams' contention that the novelty of his work may have offended allegedly domesticated tastes; explores the relationship between modern audiences and modern literary art. Chapter II considers further Williams' claim of novelty by comparing his works with those of his predecessors. Chapter III discusses the characterization of Camino Real, particularly Williams' conceptions of Don Quixote, Lord Byron, Jacques Casanova, and Marguerite Gautier. Chapter IV seeks to demonstrate that the dramatis personae of Camino Real represent characterization patterns which typify Williams' other works and, in relation to these other works, may be notable. Chapter V and Chapter VI propose that Williams' use of symbols and situations in Camino Real are potential distractions for an audience unfamiliar with the rest of his literary canon. Chapter VII, re-asserting the intentionally unbiographical scope of this study, summarizes the relationship between Williams' publications and modifiers of verbal communication.

The writing of this dissertation may be justified if it encourages the reader to contemplate within his own life the frequently unchallenged deceptions of word use. It may also earn an unacademic raison d'etre in suggesting the anguish undergone by a human being who raises his voice against man's incomprehension of man only to discover himself uncomprehended--and this in an age of "mass communication." Microfilm $2.75; Xerox $9.40. 209 pages.

JANSENIST OPPOSITION TO THE THEATRE: 1657-1715.

(L. C. Card No. Mic 59-5593)

Jonny L. Young, Ph.D.
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Opposition to the theatre in seventeenth-century France was based almost exclusively on theological authority. The most violent opponents to the theatre during the century were the Jansenists. This dissertation attempts to establish as exactly as possible the nature and results of the Jansenist opposition. The collection of Jansenist documents at the Folger Shakespeare Library has formed the nucleus for an understanding of the severe attitude the Jansenists expressed toward the stage. All known Jansenist writings against the theatre and the various replies to these writings have been examined. Of primary importance are the works of Pierre Nicole, whose attacks on the theatre in the 1660's destined him to be considered the spokesman for his Jansenist colleagues. Methods of education at the schools of Port-Royal, the heart of the Jansenist community, have been studied in order to furnish a further understanding of the Jansenist viewpoint.

Jansenist controversy with the theatre had many consequences. Their outburst against the stage was a point of departure for continued controversy. It led directly to the Caffaro-Bossuet dispute of 1694, in which echoes of the earlier Jansenist attacks are heard. The same line of argument is also apparent as late as the eighteenth century when Rousseau launched his attack against the theatre, with the notable exception of the difference in sources of authority. The Jansenists were also responsible, at least to some degree, for Racine's eventual retirement from the stage.

Another endeavor of this work is to show the ironic and unintentional contributions of the Jansenists toward the theatre they so despised. At Port-Royal men such as Nicole, Lancelot and Le Maître were greatly influenced by Cartesianism, a philosophy foreign to and somewhat altered from Saint-Cyran's original ideas on the education to be employed at Port-Royal. Racine, who so earnestly defended the theatre against the attacks of Nicole, later praised his former Port-Royal teachers for having taught him to reason for himself. These teachers embued him with a love for classical language and literature. Their influence actually helped produce the greatest playwright of the century.

It is conceivable that the opposition to the theatre in France would have subsided far earlier had it not been for the turmoil created by the Jansenists. Particularly exhaustive in their research, their presentation of the Church's position was well-documented; indeed, there was little need for further exploration of this nature in the succeeding disputes. The Jansenists had done the groundwork and had formed a strong platform for future assailants. Microfilm $2.50; Xerox $7.60. 163 pages.

ESTUDIOS ESTILISTICOS DE LAS RIMAS DE GUSTAVO ADOLFO BECQUER. [SPANISH TEXT].

(L. C. Card No. Mic 59-5847)

Robert James Young, Jr., Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Lloyd A. Kasten

The primary purpose of these studies is to reveal the sources of the poetic expression of the Rimas.

Parallelisms are the most fundamental characteristic of Bécquer's style. There can be identified a variety of basic types of parallelisms founded on syntax, morphology, concept, rhythm, word order, metrical feet, verbal aspect, rhyme, etc., several of which frequently appear in a given composition, where they are distributed either in an independent or an interlocking manner, and where each of the elements receives an emphasis appropriate to a total pattern of balance.

In cases where a syntactical parallelism is complete and extensive, the rhythmical parallelism will, for the most part --with the exception of a single pair in which the syntactical and rhythmic patterns are fused--, operate separately. Where the syntactical pattern is of a skeletal nature, being completed by morphological elements whose order of appearance is not parallel, the rhythmical parallelism may function in a syntactical sense. This suggests the reestablishment of word order on a parallel basis with regard to repeated syntactical groups in such a fashion as to create the illusion that the morphological parallel is syntactic in character. This illusion is psychological but not syntactic.

The division of a syntactic construction into two parts --and under certain supporting parallelistic conditions peculiar to each instance-- serves a variety of expressive functions. In Rima LIII the partition of a verbal phrase facilitates the emergence of a second meaning which is not based upon logic and grammar, but, rather, on anaphorical and parallelistic factors such as word order, morphology, semantic contrast, etc. This meaning enhances the emotional and artistic quality of the poem.

In Rima XVI the temporal aspect of a subordinate clause is greatly reduced --if not lost--, because of its position within a split conditional clause whose conditionality is accentuated because it contributes to the static, spiritual and immaterial qualities of the tone of the composition. These subjective and sentimental qualities are further supported by lexical and syntactic relationships which are psychological rather than logical.

Through the poet's use or failure to use such devices as word order, anaphora, morphological similarities, adversative and coordinating conjunctions, etc., the reader mistakenly assumes that incomplete syntactic parallelisms are complete and extensive, but is unaware of their presence in other poems --Rima VI--, where every single element is parallelistic.

Bécquer conceals the presence and/or the underlying functions of parallelisms, and frequently inverts their meaning with regard to the expression of the logical or the imaginative. Their extension and purpose, their types and mutual relationships, the psychological significance of the incorporation of morphological constructions into a syntactic parallelism, the general functions of syntax

on a psychological (subjective) rather than a logical basis, and the functions of rhythmic and musical parallelisms within those of the syntactic and morphological system are unquestionably not understood, but only vaguely felt by the sensitive reader.

Through the use of parallelisms, Bécquer entices the reader into the acceptance of his own specific feelings and beliefs regarding the nature and relationship of interior and of objective reality, of fact and fancy, of his world-view. He induces one to interpret logical relationships as subjective fantasy; and fantasy as an objective and rational entity.

The antithetical parallelisms based on the opposition or fusion of the psychological and the logical coincide with other thematic and lexical contrasts: reality-fantasy, spirit-thing, You-Me, etc. The former constitute the emotional, lyric and poetic bases for the expression of the latter. Microfilm $2.50; Xerox $8.60. 188 pages.

LAW

FUNDAMENTAL CONCEPTS IN CONSIDERING HOME RULE FOR NEW ENGLAND TOWNS AND CITIES

(L. C. Card No. Mic 59-3449)

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Boston University Graduate School, 1959

Major Professor: Professor Lashley G. Harvey

This dissertation is basically a study of the nature of the state-local constitutional relationship and division of powers in the various New England states, past, present and prospective. The problem with which it is concerned is the definition of the constitutional and legal status of the New England municipality in general, and the New England town in particular. The principal medium used to explore this relationship is the New England political or social myth-like concept of local independence, however conceived and in whatever guise. This concept is traced from its historical origins in the independent actions of the colonial New England towns, through the facts and theories accompanying the centralization of the nineteenth century, to present day home rule and allied movements and theories in the New England states.

The primary purpose is to examine the varying theories, rules of interpretation, and political and jurisprudential theories which continued assertion of the concept engendered. These resultants are shown to have created a judicial pattern and political climate, the limits of which will determine the need for home rule, and the chances for success of varying types of constitutional or statutory home rule provisions, in the New England states.

The thesis is that this tradition of local independence, however conceived and in whatever guise, remains a fact of present day practical significance in New England, constantly shaping the nature of municipal powers and of the status of the municipality in relation to the state; further, it is that the pragmatic use of the concept in an attempt to secure local independence of action in local affairs was an important and relevant antecedent to the modern home rule movement and that the ideas underlying and purposes motivating each are similar; finally, that the home rule movement, to succeed in any of these states, must mold its "grass roots" campaign, its home rule enabling statutes, and its constitutional amendments so as effectively to: (1) "capture the decencies" by showing the home rule movement as a natural outgrowth of the New England tradition that the New England municipality is somehow different from local units elsewhere, and thus has or is deserving of somewhat enhanced status vis a vis the state, and (2) make use of the knowledge and warnings contained in the web of statutes, court decisions, and theories engendered by past attempts to assert claims to local independence, to make certain that the various New England courts will not be able to nullify or restrict their effectiveness by applying the same legalistic rules and standards which they developed and applied in striking down the earlier attempts to secure local independence of action in local affairs.

The author has modeled his presentation upon the classical political science writings of Professors Frank J. Goodnow and John A. Fairlie, and has followed the methodology employed in Goodnow's Municipal Home Rule. Accordingly, the steps employed are: (1) formulation of the theoretical framework, definition of the problem, and initial analysis in broad terms, (2) intensive analysis of relevant documentary and critical materials, and (3) the formulation of conclusions therefrom, including the discernment of trends, past and prospective.

Microfilm $7.65; Xerox $26.20. 603 pages.

NETWORK RINGS AND ALGEBRAS

(L. C. Card No. Mic 59-5660)

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Supervisor: Dr. Bernard Vinograde

An important problem of ring theory is that of cleavage of nonsemisimple rings. A ring is cleft if it is the group direct sum of the radical and a semisimple subring which is isomorphic to the quotient ring modulo the radical. Semisimple subrings which satisfy this property are called Wedderburn factors. The Wedderburn principal theorem guarantees that separable algebras are cleft, while a theorem of Malcev states that the Wedderburn factors for the separable case are related by an inner automorphism of the algebra.

The present study concentrates on a particular type of cleft ring. These rings are generated by their semisimple subrings and are labeled network rings. The existence of network rings is guaranteed by explicit constructions. Thus, for any given positive integer there is a network algebra with that number of generators. Although some of the examples are subsumed under the Malcev theorem, others are actually inseparable algebras modulo the radical.

It is shown in this thesis that if a semiprimary ring is network then a certain set of associated primary rings must be network. In addition, a primary ring is network if and only if the associated completely primary ring is network.

Using these foundations, an analysis is made of completely primary network rings. Thus if a completely primary network algebra is embedded in a complete matric algebra the Wedderburn factors must be related by inner automorphisms of the matric algebra. A sequence of theorems describes the consequences of these automorphisms being inner.

Finally, representation theory is introduced to give necessary and sufficient conditions for an algebra generated by two division subalgebras to be network. An additional theorem provides a criterion for the inner automorphism described above to be given by an element in the network algebra generated.

The thesis concludes with results concerning the regular representation of network algebras. The known theory of the regular representation is used to characterize the element giving the inner automorphism.

Microfilm $2.50; Xerox $3.00. 36 pages.

SIMPLEX-SUM DESIGNS — A CLASS OF SECOND ORDER ROTATABLE DESIGNS DERIVABLE FROM THOSE OF FIRST ORDER

(L. C. Card No. Mic 59-6566)

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Supervisor: Robert John Hader

A class of designs, called simplex-sum designs, for fitting the second order response surface model

$$\eta = \beta_0 + \sum_{i=1}^{k} \beta_i x_i + \sum_{i=1}^{k} \sum_{j=i}^{k} \beta_{ij} x_i x_j ,$$

is described. These designs are rotatable, implying that the variance of an estimated response at any point obtained from the least squares regression equation, is a function only of the distance of that point from the center of the design configuration in the factor space.

To generate a simplex-sum design for k factors, an arbitrary (k+1) by k matrix D_1 is chosen whose column vectors are orthogonal to each other and to a vector of ones and have the common vector length $\sqrt{k+1}$. The k + 1 row vectors of such a matrix describe the vertices of a regular k dimensional simplex and provide a minimum first order rotatable design, i.e., a design suitable for estimating the first k + 1 coefficients of the above model. The rows of the first order design matrix D_1 are then used to generate the matrices $D_2, D_3, \ldots, D_s, \ldots, D_k$ where D_s is an $\binom{k+1}{s}$ by k matrix whose rows consist of all possible sums of the row vectors of D_1 taken s at a time. Allowing each resultant matrix D_s to be modified through scalar multiplication by an arbitrary constant a_s, a new N by k design matrix is formed having these matrices as horizontal partitions, where $N = 2^{k+1} - 2$. Second order rotatable designs are then obtained by suitable choice of the constants $a_1, a_2, \ldots, a_k$ (called radius multipliers).

Two forms of solutions for the radius multipliers are given. The first is a general expression holding for all k which, after adding points at the center of the design, will always provide a rotatable second order design. Other specific solutions are listed for $5 \leq k \leq 8$ which require fewer points since some of the a_s values are zero. These latter solutions also provide a means of easily generating additional simplex-sum designs.

Blocking schemes are provided for these designs as well as a method for partially replicating the designs while retaining rotatability. A general theorem is developed showing the moment conditions imposed on the blocks if non-orthogonal blocking is to be used without destroying the rotatable property of any second order rotatable design.

General formulas for the sampling moments of finite multivariate orthogonal populations with zero means are given. These results should find application outside the field of experimental design although they were developed

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here to express the moments of D_s as a function of the moments of the first order design matrix D_1.

Microfilm $2.50; Xerox $5.40. 106 pages.

CONTRIBUTIONS TO THE STATISTICAL ANALYSIS OF EXPERIMENTS WITH ONE OR MORE RESPONSES (NOT NECESSARILY NORMAL)

(L. C. Card No. Mic 59-6429)

Vasant P. Bhapkar, Ph.D.
The University of North Carolina, 1959

Supervisor: S. N. Roy

In Part I of this thesis, we are concerned with experimental data given in the form of frequencies in cells determined by a finitely multi-way cross-classification, with predefined categories along each way of classification. We pose hypotheses, which might be considered to be generalizations appropriate to this set-up of the usual hypotheses in (i) classical "normal" univariate "fixed effects" analysis of variance or ANOVA, (ii) "normal" multivariate "fixed effects" analysis of variance or MANOVA, and (iii) analysis of various kinds of "normal" independence.

According as a set of values is or is not associated with the categories along any way of classification (factor or response) that way of classification is said to be structured or unstructured. In the structured case, problems involving certain over-all aspects of the distribution are posed and studied.

Large sample tests for the problems posed are offered. These are based on the frequency χ^2 test of Karl Pearson. However, part I of this thesis is along the line, historically going back to Barnard and E. S. Pearson for the 2 x 2 table, but developed independently and extensively for more general cases by Roy, Mitra, Ogawa and Diamond. The mathematical methods used are the ones introduced by Cramer and further developed by Mitra, Ogawa and Diamond.

The theorem on minimum χ_1^2 is proved here along Cramer's lines, and an independent justification for Neyman's linearization technique is given. It has also been shown that for linear hypotheses the minimum χ_1^2 is the same as the one obtained by the "general least squares" approach on some asymptotically normal variables.

Part II considers, broadly speaking, the same problems as Part I, but under the usual probability models of the nonparametric inference. To start with, Mood's test for the two-way classification has been extended to cover incomplete block situations. An extension of Hoeffding's theorem on U-statistics is proved and a new test criterion for the problem of c samples is offered. In particular, it has been shown that if we have $n_1, n_2, \ldots, n_c$ independent observations from populations with distribution functions F, G, ..., H respectively, $v^{(k)}$ is the number of c-plets that can be formed by choosing one observation from each sample such that the observation from the k-th sample is the least and F = G = ... = H, then

$$N(2c - 1)\left[\sum_{i=1}^{c}\frac{n_i}{N}(u^{(i)} - \frac{1}{c})^2 - \{\sum_{i=1}^{c}\frac{n_i}{N}(u^{(i)} - \frac{1}{c})\}^2\right],$$

where $N = \sum_{i=1}^{c} n_i$ and $u^{(i)} = \frac{1}{n_1 n_2 \ldots n_c} v^{(i)}$, is asymptotically distributed as a χ^2 with c - 1 d.f.

Mood and Brown's methods for regression problems are extended to study some more regression problems, especially those arising in the case of c samples. These extensions are then used in the step-down procedure to test the usual hypotheses in the bivariate analysis of variance. Microfilm $2.50; Xerox $6.40. 135 pages.

GROUPS AND SEMIGROUPS IN TOPOLOGICAL DYNAMICS

(L. C. Card No. Mic 59-4604)

Hsin Chu, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor W. H. Gottschalk

In this paper, we investigate several problems derived from topological dynamics.

Historically, discrete flows and continuous flows have played the most important roles in topological dynamics. A discrete flow is a transformation group whose phase group is the additive group I of all integers with the discrete topology. A continuous flow is a transformation group whose phase group is the additive group R of all real numbers with the usual topology. A subset H of a topological group G is called syndetic if there exists a compact subset K of G such that $\overline{G = H.K}$. A topological group is called bonded if every non-trivial cyclic subgroup is syndetic. As we know, the almost periodicity properties of transformation groups are based on syndetic subsets of the phase group. The following problem is interesting: "What is the structure of a bonded group?" The main result given in Chapter I is as follows: Every bonded group G is either a compact group, a non-locally-compact radical group such that each non-trivial cyclic subgroup of G is not discrete or a locally compact group such that each non-trivial cyclic subgroup of G is discrete.

A locally compact group G satisfies condition (A) if G contains no compact subgroup except identity, but contains a syndetic, non-trivial cyclic subgroup. As we know, I and R are groups with condition (A). In Chapter II, we consider the following problem: "What is the structure of a locally compact group G which satisfies the condition (A)?" Our answer to this problem is as follows: "A group satisfying condition (A) is either I or R." Making use of this result, the solution to the former problem would be as follows: Every bonded group is one of the following four types: (1) compact, (2) (I, (3) R or (4) non-locally-compact radical group.

Let (X, T, π) be a transformation group where X is a nonvacuous compact Hausdorff space and the phase group T is a separated topological group. Let G denote the transition group π^t $t \in T$ of (X, T, π). Let E denote the enveloping semigroup of (X, T, π) which is defined to be the closure of G in the cartesian power X^X provided with its topology of pointwise convergence. In Chapter III, we study the structure of E and the almost periodicity of (X, T, π). The main results are as follows:

(A) Let I be a minimal right ideal in E. Let U_I be the set of all idempotents in I. Then there exists a closed equivalence relation R in E, such that E|R is a group and I U_I is a continuous one-to-one image of E|R. If the proximal relation of (X,T,π) is a closed equivalence relation, then I U_I = E|R.

(B) Let T be abelian, and let E contain only continuous functions. Then the following statements are equivalent:

(1) (X,T,π) is distal
(2) (X,T,π) is pointwise almost periodic
(3) (X,T,π) is almost periodic
(4) E is a group of homeomorphisms of X onto X.

(C) Let $a \in X$ such that $aT = X$ and let E be abelian. Then X has a unilaterally continuous semigroup structure with identity. Microfilm $2.50; Xerox $3.00. 57 pages.

ON SOME THEOREMS OF OSTMANN ON THE ASYMPTOTIC DENSITY OF THE SUM OF SETS OF POSITIVE INTEGERS

(L. C. Card No. Mic 59-5542)

Robert Edward Clark, Ph.D.
The University of North Carolina, 1959

Supervisors: Alfred T. Brauer and Hans Rohrbach

Let $\mathcal{A}$ and $\mathcal{B}$ be sets of positive integers. We denote by $\mathcal{A} + \mathcal{B}$ the set of all integers a, b, or a + b where a is in $\mathcal{A}$ and b is in $\mathcal{B}$. The number function for any set $\mathcal{C}$ of positive integers is defined by: for each non-negative integer x, we define C(x) as the number of integers in $\mathcal{C}$ that are not greater than x. The Schnirelmann density of $\mathcal{C}$ is the greatest lower bound of the set $\{\frac{C(x)}{x}$ for $x = 1,2,3,..\}$ and is denoted by $D(\mathcal{C})$. The asymptotic density of $\mathcal{C}$ is the limit inferior of the sequence $\{\frac{C(x)}{x}\}_{x=1}^{\infty}$ and is denoted by $D^*(\mathcal{C})$.

The concept of density was introduced by L. Schnirelmann in 1930, and during the following decade many mathematicians attempted to find lower bounds for the Schnirelmann and asymptotic densities of $\mathcal{A}+\mathcal{B}$. In 1942, H. B. Mann proved the long-standing conjecture that the Schnirelmann density of $\mathcal{A}+\mathcal{B}$ is not less than the sum of the Schnirelmann densities of $\mathcal{A}$ and $\mathcal{B}$, provided this sum is not greater than 1. Although the sum of the asymptotic densities of $\mathcal{A}$ and $\mathcal{B}$ is not a lower bound for the asymptotic density of $\mathcal{A}+\mathcal{B}$, Hans-Heinrich Ostmann showed in 1941 that if j is the smallest positive integer i such that A(i) + B(i) < i then the asymptotic density of $\mathcal{A}+\mathcal{B}$ is not less than the product of $\frac{j}{j+1}$ and the limit inferior of the sequence $\{\frac{A(x) + B(x)}{x}\}_{x=1}^{\infty}$. In 1953, Hans Rohrbach and Bodo Volkmann obtained a simpler proof of Ostmann's Theorem. In this dissertation, the proof of Rohrbach and Volkmann is further simplified and some minor errors are corrected. Microfilm $2.50; Xerox $3.00. 24 pages.

CONTRIBUTIONS TO UNIVARIATE OR MULTIVARIATE ANALYSIS OF VARIANCE WITH FIXED EFFECTS, NORMAL OR NONNORMAL RANDOM EFFECTS, AND NORMAL ERROR.

(L. C. Card No. Mic 59-5543)

Whitfield Cobb, Ph.D.
The University of North Carolina, 1959

Supervisor: S. N. Roy

Chapter I lists some less familiar properties of matrices and bilinear forms and proves some other lemmas.

Starting from a univariate model in which each observation is assumed to be the sum of three terms called treatment effect, block effect, and error, Chapter II derives, by orthonormal transformations on the observations obtained from an experiment with any connected design, three sets of statistics whose distributions are respectively free of block effects, free of treatment effects, and free of both. Chapter III shows that the usual tests and estimates of fixed treatment effects can be carried out using these statistics, provided the error is assumed to be normal, without making any assumption as to the nature of the block effects.

The main problem of Chapter III is to obtain confidence bounds on some measure of the dispersion of random block effects without knowing or postulating the type of distribution. This is accomplished subject to approximating by a histogram of k columns the density curve of the unknown distribution. Relying upon the postulated independence of block effects and errors, a probability statement (here called "preliminary" or "quasi-" confidence statement) about a quadratic form in the unobservable block effects is found whose confidence limits and quasi-confidence coefficient depend upon the normal distribution of the errors, not upon the unknown distribution. For a large class of designs determined in Chapter II, these quasi-confidence bounds can be combined with a discrete probability distribution to yield confidence bounds on the differences between successive odd 2k-tiles of the unknown distribution of block effects. The shape of this confidence region and the a priori factor of the confidence coefficient are expressed in terms of s, the number of blocks, for k = 2,3,4,5.

Chapter IV starts with a multivariate model (in which p characteristics of each experimental unit are observed, but otherwise like the model of Chapter II) and derives suitable sets of statistics--p-column matrices--by the same orthonormal transformations. Chapter V shows how, by using these statistics, the hypothesis of equal fixed treatment effects may be tested, the variance matrix of the normal errors may be estimated, and confidence bounds placed on the characteristic roots of this matrix, whether the block effects are assumed to be fixed, normal, or nonnormal random.

The chief accomplishment of Chapter V is confidence bounds on the characteristic roots of the variance matrix of the block effects when the latter are assumed to have a p-variate normal distribution. This is done by means of preliminary or quasi-confidence bounds without the restrictive assumption of proportionality of the variance matrices of block effects and errors.

Also in Chapter V marginal and conditional m-tiles are defined for a multivariate distribution, and the problem of finding confidence bounds on differences between

successive odd m-tiles is posed. The confidence coefficient and the shape of the confidence region have been determined only for the interquartile differences of a bivariate with the simplest relation between the two variates.

Microfilm $2.50; Xerox $7.00. 149 pages.

ON THE WORD PROBLEM FOR LATTICES AND RELATED TOPICS

(L. C. Card No. Mic 59-5371)

Richard Albert Dean, Ph.D.
The Ohio State University, 1953

The word problem for lattices is formulated as follows: A lattice is considered as an abstract algebra possessing generators and obeying the lattice axioms and certain defining relations given a priori. The problem asks that a canonical process be given for determining, in a finite number of steps, whether two words, i.e., two expressions on the generators, represent the same element of the lattice. In 1941 this problem was solved for free lattices by Whitman,[1] and just recently a solution for certain classes of abstract algebras which include lattices has been given by Evans.[2]

Chapter 2 of the dissertation adapts Evans' general method to lattices and obtains a solution to the word problem for lattices. The resulting process turns out to be laborious in practice and disappointing in that it does not seem to help in solving related problems. Chapter 4 of the dissertation defines a class of lattices for which the word problem is solved in a manner analogous to Whitman's method. These lattices are the completely free lattices generated by partly ordered sets.

Let P be a partly ordered set of elements, p_i, with order relation [$\geq$]. Let Q be the set of lattice polynomials (words) formed from the p_i, the lattice operations union [$\cup$], and intersection [$\cap$]. The polynomials can be quasi-ordered [$\geq$] as follows:[3]

Definition. — Let A and B be two polynomials. $A \geq B$ if and only if one or more of the following hold:

(1) $A \equiv p_i$, $B \equiv p_j$, and $p_i \geq p_j$ in P.

Proceeding recursively,

(2) $A \equiv A_1 \cup A_2$ and $A_1 \geq B$ or $A_2 \geq B$,

(3) $A \equiv A_1 \cap A_2$ and $A_1 \geq B$ and $A_2 \geq B$,

(4) $B \equiv B_1 \cup B_2$ and $A \geq B_1$ and $A \geq B_2$,

(5) $B \equiv B_1 \cap B_2$ and $A \geq B_1$ or $A \geq B_2$.

It is easily seen that it can be decided in a finite number of steps whether $A \geq B$ or $A \not\geq B$. An equivalence relation [=] is then introduced on Q: A = B if and only if $A \geq B$ and $B \geq A$. It is then easy to show that the resulting equivalence classes form a lattice in which P is embedded and in which only the order of the elements in P is preserved. This lattice is called the completely free lattice generated by P, CF(P). Any other lattice in which P can be embedded is a homomorphic image of CF(P). Since $A \geq B$ or $A \not\geq B$ can be decided, the word problem is solved for CF(P).

The lattice usually considered as the one generated by a partly ordered set, P, preserves not only order but also the least upper and greatest lower bounds of pairs of elements when they exist in P.[4] It is to this class of lattices, when P has only a finite number of orderings, that the Evans solution applies. However, in many interesting cases the two lattices are identical. Necessary and sufficient conditions on the partly ordered set for these lattices to be identical are given. In these cases the solution to the word problem existing for completely free lattices proves to be a useful tool. In particular, it is shown that the free lattice generated by the partly ordered set consisting of two unrelated two-element chains contains infinite ascending and descending chains. This lattice has generators t, u, v, and w, and two defining relations, $t \cup u = t$ and $v \cup w = v$. An infinite descending chain is defined inductively by $A_1 = t$ and $A_{n+1} = \Big[[(A_n \cup w) \quad v] \cup u \Big] \cap t$.

A dual definition gives an infinite ascending chain. Moreover, this lattice is shown to be a sublattice of the free lattice generated by the partly ordered set consisting of one chain of four elements and a single incomparable element. This lattice has generators w, x, y, z, and u, and the defining relations $w = w \cup x$, $x = x \cup y$, and $y = y \cup z$.

The sublattices of the completely free lattice generated by a partly ordered set are investigated. The results generalize some of those found by Whitman[5] for free lattices on unordered generators. The following theorem is typical:

Theorem Let P be a partly ordered set and let $U = [u_i]$ be a finite subset in CF(P). Suppose that $u_j \leq \bigcup_{i \in T} u_i$, or its dual, imply that there exists a subscript k in T such that $u_j \leq u_k$ in U. Let $Y = [y_i]$ be a partly ordered set, order isomorphic to U by $u_i \rightarrow y_i$. Then the sublattice L of CF(P) generated by U is lattice isomorphic to CF(Y).

The method of solution given by Evans formally applies to modular lattices as well. In Chapter 3 an example is given to show that the method is ineffective for modular lattices. The word problem for modular lattices remains unsolved.

Chapter 2 is devoted to a study of congruences. The concept of weak projectivity due to Dilworth[6] and the concept of a lattice congruence generated by collapsing a set of quotients are used to show that the word problem for lattices is equivalent to deciding, given an arbitrary congruence on a lattice, whether two elements are congruent. As a lemma for this result it is shown that if C_1 and C_2 are two congruences generated by sets of quotients Q_1 and Q_2 respectively, then $C_1 \cup C_2$ is generated by the set of quotients $Q_1 + Q_2$. Microfilm $2.50; Xerox $6.00. 124 pages.

1. Whitman, P. "Free Lattices I," Ann. of Math. (2) 42 (1941), pp. 325–30.

2. Evans, T. "The Word Problem for Abstract Algebras," Jour. London Math. Soc., 26 (1951), pp. 64–71.

3. The symbol [$\equiv$] denotes the logical identity of two words.

4. Dilworth, R. P. "Lattices with Unique Complements," Trans. Amer. Math. Soc., 57 (1945), pp. 123–54.

5. Whitman, P. "Free Lattices II," Ann. of Math. (2) 43 (1942), pp. 104–15.

6. Dilworth, R. P. "The Structure of Relatively Complemented Lattices," Ann. of Math. (2) 51 (1950), pp. 348–59.

Abstract published by special arrangement with The Ohio State University.

A CRITICAL ANALYSIS OF PROCEDURES FOR EVALUATING STUDENT TEACHERS IN SECONDARY MATHEMATICS

(L. C. Card No. Mic 59-5380)

John James Evans, Ph.D.
The Ohio State University, 1953

The Problem

This study was designed (1) to determine what methods of evaluating student teachers of mathematics are now in use; (2) to investigate the factors in student-teaching programs that exert a major influence upon the evaluation process; (3) to suggest some guiding principles for evaluation of mathematics student teachers; and (4) to propose some techniques which may contribute to improved evaluation of the student teacher in mathematics.

Method

In this study the student teaching programs of a selected group of institutions were examined, particular emphasis being placed upon the techniques of evaluating student teachers in mathematics. Data concerning these programs were secured by questionnaire. In addition to this data, a review of the available literature was made and a number of evaluation instruments, contributed by the various institutions responding to the questionnaire, were examined. Replies to the questionnaire were received from 256 of the 366 persons to whom it was submitted. An effort was made to select individuals having a primary interest in the training of mathematics teachers. The procedures employed in this selection were as follows:

(1) Specialists in mathematics education who, during the preceding five years, had participated in programs of the National Council of Teachers of Mathematics devoted to the education of mathematics teachers

(2) Supervisors of mathematics student teachers, directors of student teaching, or heads of education departments who were members of the Association for Student Teaching during the year 1951-52, and who were located in institutions from which no representative had been selected in (1)

(3) Deans of colleges of education or heads of institutions engaged in teacher education listed in the Educational Directory whose enrollments were approximately 400 or more and from which no representative had been selected in (1) and (2)

These 366 persons were distributed geographically in 45 states and the District of Columbia.

Summary of Conclusions and Recommendations

Student Teaching Evaluation

An analysis of the data secured concerning the student teaching programs in various institutions shows widely differing practices. Persons responsible for evaluation should recognize the important influence of such factors as the adequacy of available laboratory facilities, the time devoted to student teaching, the persons responsible for supervision and evaluation, and the kind of conferences held. Evaluation must be conducted in reference to the total structure in which the student and the supervisor are operating. The extent to which certain methods of evaluation can be utilized meaningfully depends upon a complex of factors.

An investigation of the literature yielded some guiding principles which have been proposed in the general area of student-teaching evaluation and in the broader area of evaluation of professional laboratory experiences. Five general guiding principles for evaluation of student teaching were accepted by the writer as a starting point for the study and development of additional guiding principles applicable specifically to the evaluation of student teaching in mathematics. Those guiding principles are as follows:

1. Evaluation of student teaching should be considered an integral part of the student-teaching process.
2. Evaluation of student teaching should be considered a continuous process.
3. Evaluation of student teaching should be a co-operative process in which the student teacher, supervising teacher, and college supervisor participate.
4. Evaluation of student teaching should involve self-evaluation by the student teacher, pupil reactions to the student teacher, evaluation of the student teacher by the supervising teacher, and evaluation of the student teacher by the college supervisor.
5. All phases of evaluation of student teaching should make their principal contribution in the area of helping the student teacher improve his competence as a prospective teacher.

As stated in the fourth principle, four types of evaluation of the student teacher were considered: self-evaluation, pupil evaluation, evaluation by the supervising teacher, and evaluation by the college supervisor. The methods used in each of these types of evaluation were investigated for the purpose of suggesting some guiding principles, relative to each, which may be applied to effect improvement in the evaluation of the mathematics teacher.

Self-Evaluation

An analysis of the data secured on self-evaluation supports the following conclusions:

1. Self-evaluation, using some type of record form, is engaged in by student teachers in mathematics in approximately three-fourths of the institutions responding.
2. Slightly more than half of the group reporting that recorded self-evaluations are made indicate that the student teacher is required to submit his self-evaluation report to the college supervisor.
3. Most of the self-evaluation instruments contributed by the respondents in this study were designed for use no more than two or three times per quarter or semester. Only a few were designed for use weekly.

4. All of the instruments except one were designed for general use in any subject area.
5. The self-evaluation instruments examined may be classified in three main categories: (a) Activity Check Lists, (b) Question and Answer Lists, and (c) Check list of Traits or Qualities to be rated.

The following guiding principles for programs of self-evaluation by student teachers of mathematics are recommended by the writer:

1. Unrecorded self-evaluation should be continuous during the student-teaching experience.
2. Comprehensive self-evaluation, through use of formal instruments, should be undertaken several times during a quarter or semester.
3. Student teachers should use more than one type of self-evaluation instrument.
4. Self-evaluation instruments should provide the student teacher with an opportunity to write comments freely.
5. Self-evaluation instruments lacking in explicit instructions or clearly defined terms should be avoided.
6. Recorded self-evaluation by the student teacher in mathematics should include the use of at least one evaluation instrument designed specifically for the area of mathematics.

Pupil Evaluation

An analysis of the data secured by the questionnaire and pertaining to pupil evaluation supports the following conclusions:

1. Approximately one-third of the institutions responding in this study make use of pupil reactions as a part of the program of student-teaching evaluation.
2. Of this one-third, at least half make use of totally unstructured pupil evaluation.
3. Most of the forms used to secure pupil reactions which were examined in this study were partially structured, emphasis being placed upon freely written comments.

The following guiding principles for pupil evaluation are recommended by the writer:

1. Student teachers should secure pupil reactions to their teaching performance.
2. Pupil evaluation should be secured about the middle of the quarter or semester.
3. The pupils should remain anonymous.
4. The type of instrument used to secure pupil reactions should be geared to the maturity level of the pupils.
5. An adequate instrument to secure pupil reactions should be partially structured and thus insure an opportunity for freely written comments by pupils.
6. The student teacher should summarize the pupil reactions and find ways of utilizing them to help improve the total student teaching-learning situation.
7. Pupil reactions should be used by the student teacher but not by the supervisors, unless the student teacher voluntarily submits them.

Evaluation by Supervising Teachers

An analysis of the data assembled which deals with evaluation by supervising teachers supports the following conclusions:

1. The evaluation by the supervising teacher is considered in determining the final grade of the student teacher in 77 per cent of the institutions responding.
2. Only 57 per cent of those responding state that the supervising teacher records his evaluation of the student teacher.
3. Eighty-nine per cent of those responding point out that the supervising teacher bases his evaluation of the student teacher upon "observations of, and conferences with, the student teacher."
4. Of the 113 forms designed for use by the supervising teacher and examined by the writer only seven were for use in the evaluation of the teaching of a single lesson.
5. One hundred two of the 113 forms were for use in mid-term or final evaluation. Four of the forms were specifically for use weekly.
6. None of the instruments examined was designed specifically for use in the area of mathematics.
7. Most of the evaluation instruments used by supervising teachers employ a scale the points of which are defined by ambiguous terms, such as good, fair, poor, average, etc.

The following guiding principles for evaluation by supervising teachers are recommended by the writer:

1. Supervising teachers should be encouraged to record comprehensive mid-term evaluations of the student teacher two or more times during the period of student teaching.
2. Instruments used in the mid-term evaluation of the mathematics student teacher by the supervising teacher should provide opportunity for recording an evaluation of the student teacher's ability to carry the responsibilities of a teacher as well as those of classroom instruction.
3. Supervising teachers should be encouraged to record evaluations of the student's teaching of a single mathematics lesson.
4. Supervising teachers should use instruments designed for use in the particular area of mathematics for making mid-term evaluations of student teachers in mathematics.

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5. Supervising teachers should use instruments of evaluation which consist of descriptions of behavior observable by the evaluator.

Evaluation by College Supervisors

The following conclusions concerning evaluation by college supervisors are supported by an analysis of the data assembled:

1. College supervisors are considered responsible for the student teacher's final grade by 75 per cent of the questionnaire respondents, but 56 per cent report that advice is secured from the supervising teacher.
2. Seventy-five per cent of the respondents reveal that college supervisors emphasize observation and conferences with the student teacher and the supervising teacher in arriving at the final evaluation of the student teacher.
3. Only 38 per cent of the respondents state that the college supervisor's final evaluation is based upon a series of recorded ratings during visits to the student teacher on the job.
4. Seventy-five per cent of the respondents report that college supervisors do make use of an evaluation form partially or totally structured in character.
5. A comparison of the percentages in (3) and (4) above reveals that a large number of college supervisors use such evaluation forms for final evaluation only, and that this final evaluation is therefore not supported by any record of evaluations made during the period of student teaching.
6. College supervisors in all the types of institutions studied gave principal emphasis in their evaluation to the "personal traits or qualities" of the student teacher.
7. College supervisors in all types of institutions gave least emphasis in their evaluation to the student teacher's "skill in conducting the drill or recitation type lesson" and "participation in school and community activities."
8. College supervisors in all the types of institutions studied placed much emphasis on evaluation of "classroom management and control" and "emotional balance and maturity."
9. Specific techniques in the teaching of mathematics which were emphasized most by college supervisors in their evaluation of student teachers were the following:
   1) Motivating by effective orientation to the lesson
   2) Utilizing current pupil interest
   3) Providing for individual differences
   4) Giving clear explanations
   5) Maintaining a balance of teacher-pupil participation.
10. The following specific techniques in the teaching of mathematics were emphasized least by college supervisors:
    1) Use of general applications of mathematics to science
    2) Use of physical devices and models
    3) Use of school and community resources
    4) Economy in use of time.
11. Thirty-three per cent of the rating forms exclusively employed by college supervisors and contributed by institutions in this study were designed for use in evaluating the teaching of a single lesson.
12. Most of the devices designed for use in evaluating the teaching of a single lesson are partially structured, providing space for the written comments of the evaluator.
13. A large majority of the evaluation forms used by college supervisors for final or mid-term evaluation consist of lists of traits or abilities to be checked, according to a scale, usually a five-point scale, with no attempt made to define each of the points in reference to the particular trait or ability to be evaluated.
14. Most of the evaluation instruments for the use of college supervisors in final or mid-term evaluation allow some space for freely written comments by the evaluator.

The following guiding principles for the evaluation of student teachers in mathematics by the college supervisors are recommended by the writer:

1. College supervisors should record evaluations of the student teacher's work several times during the student-teaching assignment.
2. College supervisors should develop and use instruments designed to record their reactions to the student teacher's handling of a single mathematics lesson.
3. College supervisors should make it a regular practice to provide the student teacher with copies of the evaluations which they make.
4. Evaluation instruments employed by college supervisors should include space for the evaluator to write comments.
5. College supervisors should make use of evaluation instruments designed specifically for use with mathematics student teachers.
6. Instruments used by college supervisors in mid-term evaluation of the student teacher should be designed to make use of descriptions of observable behavior.
7. College supervisors should make use of a variety of appropriate evaluation instruments. (This includes anecdotal records, check lists of teacher activities, structured and unstructured forms for evaluation.)
8. The evaluative criteria to be used for judging the work of student teachers of mathematics should be understood and accepted by student teachers and supervisors alike.

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9. The evaluative criteria used in instruments for the evaluation of mathematics student teachers should include those criteria applicable to student teaching which have been applied in the evaluation of previous laboratory experiences.

Suggested Evaluation Instruments for the Use of Supervisors

Three instruments designed by the writer for the use of supervisors in the evaluation of mathematics student teachers are presented. Two of these are intended for use in evaluating the teaching of a single mathematics lesson, and the other is for use in mid-term evaluation. These instruments are intended to be illustrative only. They constitute an attempt to suggest what kinds of evaluation instruments result if the guiding principles recommended in this discussion are applied to the task of developing appropriate instruments for evaluation. The strengths and weaknesses of the proposed instruments are discussed in detail.

The first of the two instruments proposed for use in evaluating the teaching of a single mathematics lesson is a general form which could be used by the supervisor as he observes the mathematics student teacher conduct any lesson whatsoever. The second instrument is an adaptation of the first, in which the section on teaching techniques in mathematics is designed for use in evaluating the student teacher as he teaches a lesson on the particular topic of solving verbal problems. This latter instrument was designed upon the basis of research into various techniques of teaching verbal problems which appear in the literature on the teaching of mathematics.

The specific nature of the instrument proposed for use in evaluating the teaching of a lesson in solving verbal problems implies that supervisors should construct similar instruments for all major topics. The magnitude of such a task is immediately recognized. It is suggested that since supervisors can evaluate in such great detail only a limited number of individual lessons taught by the student teacher, the construction of such instruments might be limited to those applicable to introductory lessons for topics with which pupils usually have considerable difficulty.

The third instrument designed by the writer is intended for the use of the supervisors two or more times during the period of student teaching. This instrument affords the supervisor a means of recording an evaluation of the student teacher which is based upon observations of his work not only in classroom teaching but also in other activities. It is a more comprehensive type of appraisal than the evaluation of the teaching of lessons in mathematics. The instrument illustrates the use of descriptions of behavior observed by the evaluator rather than lists of traits or qualities which are to be rated on a scale. The supervisor is asked to check the statements which seem to him to describe the student teacher who is being evaluated. The emphasis in this instrument is upon recording evidence rather than upon formulating judgments concerning the student teacher's performance. Such evaluation provides suggestions for improvement to the student teacher as well as bases for a final grade. The use of this kind of evaluation instrument is limited by its length and the time which is required to complete it.

Recommendations for Further Research

1. It is recommended that institutions which are engaged in the preparation of mathematics teachers conduct extensive research which may contribute to a determination of the critical factors in the success or failure of student teachers.
2. It is recommended that supervisors of student teachers in mathematics experiment with the type of instrument proposed in this study for the evaluation of a single lesson in order to determine its usefulness as a means of communicating suggestions for improvement to the student teacher.
3. It is recommended that supervisors of student teachers in mathematics devise a series of instruments pertaining to the teaching of several topics in arithmetic, algebra, and geometry, and appraise their effectiveness through applying them to the evaluation of several groups of student teachers in mathematics.
4. It is recommended that supervisors of student teachers in mathematics develop and experiment with more meaningful instruments of evaluation which employ descriptions of observable behavior.
5. It is recommended that research be conducted in the development of evaluation instruments for the use of supervisors which may also be used by the student teachers in self-evaluation.
6. It is recommended that supervisors of student teachers in mathematics encourage student teachers to experiment with various methods of securing and of analyzing pupil reactions to their teaching ability.

Microfilm $5.00; Xerox $16.60. 390 pages.

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AN INVESTIGATION OF SOME MULTIPLE REGRESSION METHODS FOR INCOMPLETE SAMPLES

(L. C. Card No. Mic 59-6568)

Charles Foster Federspiel, Ph.D.
North Carolina State College, 1959

Supervisor: Robert James Monroe

Four methods for obtaining prediction equations from fragmentary multivariate normal populations have been studied using an empirical sampling approach.

The methods are (1) the trivial solution obtained by deleting observation vectors which are not complete in every variate; (2) a technique identified as the Method of Paired Correlation Coefficients which involves the sample correlation matrix from all available pairs of the n_{ij} variate values, a solution for the standardized regression coefficients and conversion to ordinary regression coefficients; (3) an iterative least squares scheme which has been referred to in this text as the Greenberg Procedure (With

this method missing variate values of x_i are replaced by estimates based on the regression of x_i on the other variates. The procedure is carried out for the necessary x_i until the regression coefficients, b_i, converge on recessive iterations.); and (4) maximum likelihood estimation for certain special cases.

Methods (2) and (3) were the primary targets for investigation. Eight sampling experiments were carried out to assess the efficiencies of these techniques and to compare all four procedures.

Conclusions resulting from this study were as follows: The Method of Paired Correlation Coefficients is relatively inefficient when applied to samples from populations, the variables of which are heterogeneously correlated; that is, populations having correlation matrices with elements of different magnitudes.

The Greenberg Procedure is not worthwhile in trivariate cases but appears to be of value when applied to certain types of higher variate samples.

Maximum likelihood estimation is superior to the other procedures in the relatively few cases where it can be readily applied.

Microfilm $2.50; Xerox $6.00. 122 pages.

ON THE GROUP OF ALL HOMEOMORPHISMS OF A MANIFOLD

(L. C. Card No. Mic 59-5514)

Gordon McCrea Fisher, Ph.D.
Louisiana State University, 1959

Supervisor: Professor R. D. Anderson

In Chapter I, preliminary definitions and theorems about manifolds are given. In Chapter II, techniques of Anderson are extended to find the smallest non-trivial ($\neq e$) normal subgroup $\underline{G}^0(M)$ of the group $\underline{G}(M)$ of all homeomorphisms of an arbitrary n-manifold $\overline{M}$, and to show that it is simple. The group $\underline{G}^0(M)$ is the set of all h in $\underline{G}(M)$ such that $h = h_1 \cdots h_k$ for some h_i in $\underline{G}(M)$ such that h_i is the identity outside some closed n-cell F_i in M lying in an open n-cell U_i in M.

In Chapters III and IV, it is shown that if M is a closed manifold of dimension ≤ 3, then $\underline{G}^0(M)$ is the group $\underline{D}(M)$ of all deformations of M, and the identity component $\underline{C}_e(M)$ in the topological group $\underline{G}(M)$; thus $\underline{D}(M) = \underline{C}_e(M)$ is simple. It is also shown that $\underline{D}(M) = \underline{C}_e(M)$ is open in $\underline{G}(M)$.

In Chapter V, it is shown that if $n \leq 3$, then $\underline{G}(S_n)$ has exactly one proper normal subgroup, simple, of index 2 and open in $\underline{G}(S_n)$. This result contains all previously known results on simplicity and index 2 for homeomorphism groups of manifolds.

In obtaining the result of Chapter V, we use the group $\underline{G}^I(M)$ of all homeomorphisms h of M which can be factored, $h = h_1 \cdots h_k$, into homeomorphisms h_i such that h_i is the identity inside some closed n-cell F_i in M. In Chapters V and VI, some preliminary results on the nature of the group $\underline{G}^I(M)$ are given. For example, if M is closed and orientable, dim $M \leq 3$, and M admits a homeomorphism of degree -1 (in the original sense of Brouwer), then an h in $\underline{G}(M)$ is of degree 1 if and only if h is in $\underline{G}^I(M)$.

In Chapter VI, it is shown that S_2 is characterized among orientable closed 2-manifolds by the fact that its homeomorphism group has exactly one proper normal subgroup.

The results of this paper on the groups $\underline{G}^0(M)$ and $\underline{G}^I(M)$ suggest that when M is orientable, one can think of $\underline{G}^0(M)$ as consisting of the orientation-preserving homeomorphisms of M, and of $\underline{G}^I(M)$ as consisting of the locally orientation-preserving homeomorphisms of M (at any rate if dim $M \leq 3$). The non-orientable case has not yet been investigated. Microfilm $2.50; Xerox $3.00. 58 pages.

SIMILARITY SOLUTIONS OF THE LAMINAR, INCOMPRESSIBLE, THREE-DIMENSIONAL BOUNDARY-LAYER EQUATIONS

(L. C. Card No. Mic 59-5989)

Arthur G. Hansen, Ph.D.
Case Institute of Technology, 1959

The paper presents an analysis of possible similarity solutions of the three-dimensional, laminar, incompressible, boundary-layer equations referred to orthogonal, curvilinear coordinate systems. The boundary-layer equations are derived from the Navier-Stokes equations and basic concepts and inherent limitations of the theory are briefly discussed.

Requirements for similarity solutions are obtained for two special cases: flow over developable surfaces and flow over nondevelopable surfaces. In the latter case mainstream velocity components are also assumed proportional. The analysis obtains permissible forms of mainstream velocity components, the square of differential of arc-length on the surface, and the similarity parameter. A basic class of surfaces is found from which all other permissible surfaces may be obtained.

Necessary and sufficient conditions are found for expressing the similarity equations in separable form. The analysis shows that separability is possible only when the surface is developable and a surface coordinate system characterized by $(ds)^2 = (dx_1)^2 + (dx_2)^2$ is employed. Approximate solutions are obtained for systems of separable equations corresponding to a wide range of permissible flows. Microfilm $2.50; Xerox $7.00. 149 pages.

ARC-WISE CONNECTEDNESS IN SEMI-METRIC SPACES

(L. C. Card No. Mic 59-5552)

Robert Winship Heath, Ph.D.
The University of North Carolina, 1959

Supervisor: F. Burton Jones

R. L. Moore's Arc Theorem states that a connected open subset of a locally connected, complete Moore space is arc-wise connected. The proof of that theorem seems to depend upon the axioms of the space to such an extent that one might hope to prove that local arc-wise

connectedness is a necessary and sufficient condition for a locally connected regular topological space which satisfies the first axiom of countability and some completeness axiom to be a Moore space. If, on the other hand, a complete Moore space is not in some sense the most general space of that type in which the Arc Theorem holds, it might be expected that the theorem would hold true in a regular semi-metric space, a space in which all but a few of the theorems stated in the first two chapters of Moore's Foundations of Point Set Theory hold true.

It is established in this thesis that the Arc Theorem cannot be generalized directly to Cauchy complete regular semi-metric spaces. The author gives examples of several Cauchy complete, locally connected, connected, completely regular semi-metric spaces which are not Moore spaces some of which are arc-wise connected, and some of which are not arc-wise connected. One of them which is not arc-wise connected is nevertheless very nearly so, being connected by irreducible connected sets which resemble arcs, while another is connected by irreducible compact continua. One of the spaces which is arc-wise connected very closely resembles those which are not arc-wise connected. The examples show rather clearly the limited nature of the progress that can be made in trying to extend the Arc Theorem to semi-metric spaces.

Several topological conditions and completeness axioms are investigated to determine which of them might be used to generalize the Arc Theorem. It is established that a regular semi-metric space is a Moore space if it satisfies a certain completeness axiom which is slightly stronger than Cauchy completeness but weaker than the completeness of Moore's Axiom 1.

Finally, the author obtains a sufficient condition for arc-wise connectedness in semi-metric spaces which is somewhat more general than Moore's theorem. The completeness axiom used is known to be weaker than that in the hypothesis of Moore's theorem and the other properties used are at least formally more general than those used by Moore. Microfilm $2.50; Xerox $3.80. 66 pages.

PROOF THAT EVERY COMPACT CONTINUUM WHICH IS TOPOLOGICALLY EQUIVALENT TO EACH OF ITS NONDEGENERATE SUBCONTINUA IS AN ARC

(L. C. Card No. Mic 59-6712)

George Walter Henderson, Ph.D.
The University of Texas, 1959

Supervisor: R. L. Moore

In 1921, S. Mazurkiewicz (Fund. Math. Vol. 2 (1921) p. 285, problem 14) raised the question whether it is true that if a continuum in space of m dimensions is topologically equivalent to every one of its nondegenerate subcontinua, then it is an arc. In 1948, making use of a certain plane indecomposable continuum (Trans. Amer. Math. Soc. vol. 63 (1948) pp. 581-594), E. E. Moise showed that this question may be answered in the negative. In the present paper it is shown that for compact decomposable continua in a metric space, the answer is affirmative.

Microfilm $2.50; Xerox $3.00. 23 pages.

UNSTABLE HOMEOMORPHISMS AND CERTAIN CONTINUA

(L. C. Card No. Mic 59-5640)

James Fredrik Jakobsen, Ph.D.
University of Missouri, 1959

Supervisor: W. R. Utz

W. H. Gottschalk ("Minimal sets: an introduction to topological dynamics" Bull. Amer. Math. Soc., Vol. 64 (1958) pp 336 - 351) lists eleven problems in topological dynamics. Problem 7 states: "What spaces can carry an unstable homeomorphism? (Gottschalk uses the equivalent phrase "expansive homeomorphism.") The n-cells? May such spaces be locally connected?"

The first question was originally asked by W. R. Utz, who raised the question as to whether there exist unstable homeomorphisms on continua. This question was affirmatively answered by R. F. Williams ("A note on unstable homeomorphism," Proc. Amer. Math. Soc., Vol. 6 (1955) pp 308 - 309) who gave two examples of continua and unstable homeomorphisms of them. However, one of the examples contains an error. In Section 2 we demonstrate this error and show that the homeomorphism on the type of continuum used by Williams in this one example fails to be unstable.

B. F. Bryant in his thesis ("Unstable self-homeomorphisms of a compact space," Vanderbilt University Thesis, 1954) obtained a partial result on the second question of Gottschalk when he essentially showed that a closed 1-cell or arc cannot carry an unstable homeomorphism. In Section 3 we extend this by showing there is no unstable homeomorphism on a simple closed curve or on a closed 2-cell.

In Section 4 we give some miscellaneous results concerning unstable homeomorphisms. Principally these results concern instability of points under a homeomorphism in relation to the instability of the homeomorphism and, also, the possible number of orbits asymptotic to fixed points under unstable homeomorphisms.

Microfilm $2.50; Xerox $3.00. 50 pages.

DIRECT AND INDIRECT REPRESENTATIONS IN THE THEORY OF CATEGORIES

(L. C. Card No. Mic 59-5991)

Arnold A. Johnson, Ph.D.
Case Institute of Technology, 1959

Given a category $\mathcal{X}$ and a full subcategory $\mathcal{A}$ of $\mathcal{X}$, a relative direct representation of an object X in $\mathcal{X}$ is defined as an object A in $\mathcal{X}$ together with a map π: X → A such that if π': X → A′ is any other map in $\mathcal{X}$ into the subcategory $\mathcal{A}$ then there exists a unique map ω: A → A′ in $\mathcal{X}$ such that $\omega\pi = \pi'$. If A lies in $\mathcal{A}$ then (A, π) is called a direct representation of X. Examples of direct representations include direct sum, quotient group, tensor product, and direct limit. It is shown that direct representations are unique up to an equivalence and that the direct representation of a relative direct representation is a direct representation. These theorems imply the associativity and commutativity of operations defined by direct

representation. A category $\mathcal{S}$ of systems is defined where the systems are constructed out of objects and maps in a category $\mathcal{A}$. Except for tensor product, the direct representations given above as examples are taken of objects in $\mathcal{S}$ where $\mathcal{A}$ is imbedded as a subcategory of $\mathcal{S}$. Existence theorems are given for direct representations of systems. A dual theory of indirect representation results if the direction of the maps is reversed.

Microfilm $2.50; Xerox $3.80. 68 pages.

INTEGRATION OF SUBSPACES DERIVED FROM A LINEAR TRANSFORMATION FIELD

(L. C. Card No. Mic 59-5465)

Edward Takashi Kobayashi, Ph.D.
University of Washington, 1959

Chairman: Albert Nijenhuis

Let M be a C^∞-manifold, and ϕ the ring of C^∞-functions on M. A vector 1-form is a linear transformation field on M, i.e. a law which assigns to each point p of M, a linear transformation h_p of the tangent space T_p to M at p. We furthermore require that h is C^∞.

If h and k are two vector 1-forms on M, we define the bracket [h, k] by

$$[h, k](u, v) = [hu, kv] + [ku, hv] - k[hu, v] - h[ku, v] - k[u, hv] - h[u, kv] + kh[u, v] + hk[u, v] .$$

By a projection operator e on a neighborhood U of p, we mean a vector 1-form e satisfying $e^2 = e$ on U. If $e_1, \ldots, e_g$ are projection operators on U, such that $\sum_{i=1}^{g} e_i = I$ on U, where I is the identity vector 1-form, then $q \to ((e_{i_1})_q + \ldots + (e_{i_k})_q)T_q$, $q \in U$, defines a C^∞-distribution $\theta_{i_1 \ldots i_k}$ on U. We see that $\theta_{i_1 \ldots i_k}$, $1 \le k \le g - 1$, are all integrable in a neighborhood of p if and only if $[e_i, e_i] = 0$ for all i in a neighborhood of p.

For a vector 1-form h, we can define its characteristic polynomial γ on M by letting $\gamma_q = \det ||\lambda \delta^j_i - h^j_i(x_q)||$, where $h^j_i(x_q)$ are the components of h_q with respect to a coordinate system covering the point q. Then $\gamma \in \phi[\lambda]$. If γ_p has a factorization over the reals R, $\gamma_p = K_1^{m_1} \ldots K_g^{m_g}$, where $g > 1$, $K_i \in R[\lambda]$, with leading coefficients 1, and K_i are all distinct and irreducible over R, then there is a neighborhood U of p, where γ has a unique factorization, $\gamma = \gamma_1 \ldots \gamma_g$ on U, satisfying (i) $\gamma \in \phi_U[\lambda]$, where ϕ_U is the ring of C^∞-functions on U; (ii) γ_i has leading coefficient 1, degree γ_i = degree $K_i^{m_i}$; (iii) $(\gamma_i)_p = K_i^{m_i}$; (iv) $(\gamma_i)_q$ and $(\gamma_j)_q$ are relatively prime for $q \in U$, $i \neq j$.

Because γ_i and $\hat{\gamma}_i = \gamma_1 \ldots \hat{i} \ldots \gamma_g$ are relatively prime at each point of U, we can find $\mu_i, \pi_i \in \phi_U[\lambda]$, satisfying $\mu_i \gamma_i + \pi_i \hat{\gamma}_i = 1$ on U. If we denote $\pi_i \hat{\gamma}_i$ by ϵ_i, then $\epsilon_i(h)$ is a projection operator on U, and $I = \sum_{i=1}^{g} \epsilon_i(h)$ on U. Hence, we obtain C^∞-distributions $\theta_{i_1 \ldots i_k}$ defined by $q \to (\epsilon_{i_1}(h)_q + \ldots + \epsilon_{i_k}(h)_q)T_q$, and all $\theta_{i_1 \ldots i_k}$, $1 \le k \le g - 1$ are integrable in a neighborhood of p, if and only if $[\epsilon_i(h), \epsilon_i(h)] = 0$, for all i, in a neighborhood of p.

If e is a projection operator on U such that $e = \epsilon(h)$ for some $\epsilon \equiv \phi_U[\lambda]$, then on U we have $e = \epsilon(h) = \sum_{i=1}^{g} \delta_i \epsilon_i(h)$, where $\delta_i = 0$ or 1.

For the further investigation of one distribution $\theta_i : q \to (\epsilon_i(h))_q T_q$, we can suppose $\gamma_p = K^m$, $K \in R[\lambda]$. If we assume that $\gamma = (\lambda - \alpha)^n$, then for a fixed k, provided the rank of $(h - \alpha I)_q^k$ stays constant for q in a neighborhood U of p, $q \to (h - \alpha I)^k T_q$ defines a C^∞-distribution ${}^k\theta$ on U, and ${}^k\theta$ is integrable in a neighborhood of p if and only if $[(h - \alpha I)^k, (h - \alpha I)^k]_q (T_q, T_q) \subset (h - \alpha I)_q^k T_q$ for all q in a neighborhood of p.

Microfilm $2.50; Xerox $3.00. 41 pages.

BOOLEAN ALGEBRAS WITH ORDERED BASES

(L. C. Card No. Mic 59-5466)

Richard Dean Mayer, Ph.D.
University of Washington, 1959

Chairman: Richard S. Pierce

In this dissertation the decomposition of Boolean Algebras (B.As.) with respect to free product is studied. In Section 2 the following results are obtained: (1) The B.A. of all finite subsets of an infinite set, and their complements, is indecomposable. (2) The free product of two infinite B.As. is not complete. (3) A free product of B.As. is projective if and only if each factor is projective. (4) A free product of B.As. is injective if and only if each factor is injective, there are a finite number of factors, and all factors except at most one are finite.

The remaining sections deal with B.As. which possess an ordered basis. A chain C contained in a B.A. B is an ordered basis for B if the zero of B is not in C and C generates all of B. It is shown that: (5) B has an ordered basis if and only if its' Boolean space X is a chain space. (6) The ordered basis C is scattered if and only if some transfinite derivative of X is empty. (7) If B is countable and C is scattered then B has a well ordered basis. (8) If C is complete and scattered then B has a well ordered basis. (9) If B has a well ordered basis, then there is a unique ordinal α and integer n such that B is isomorphic to the B.A. $B(\overline{\omega^\alpha n})$ of all open and closed sets in the space of ordinals less than or equal to $\omega^\alpha n$. (10) If α is uncountable and $n = p_1 \cdots p_r$ then $B(\overline{\omega^\alpha n})$ is isomorphic to the free product $B(\overline{p_1}) * \cdots * B(\overline{p_r}) * B(\overline{\omega^\alpha})$ where each factor is indecomposable. (11) If α is countable and $\alpha = \omega^{\beta_1} m_1 + \cdots + \omega^{\beta_s} m_s$, where $\beta_1 > \beta_2 > \cdots > \beta_s \ge 0$ and $m_1, \cdots, m_s$ are positive integers, then $B(\overline{\omega^\alpha n})$ is isomorphic to the free product $B(\overline{p_1}) * \cdots * B(\overline{p_r}) * [B(\overline{\omega\omega^{\beta_1}})]^{m_1} * \cdots * [B(\overline{\omega^{\beta_s}})]^{m_s}$ with each factor indecomposable. (12) Apart from order, these factorizations are unique.

Microfilm $2.50; Xerox $3.00. 41 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

EXTENSION OF CONTINUOUS MAPPINGS FROM DENSE SUBSPACES

(L. C. Card No. Mic 59-6495)

Robert Hull McDowell, Ph.D.
Purdue University, 1959

Major Professor: Leonard Gillman

Important work in the theory of extension from dense subspaces was done by Stone [14] and Čech [3] in 1937, and by Hewitt [10] in 1948. This thesis is an extension (and in some cases a simplification) of their results.

In Chapter I, we study the problem of extending a continuous mapping ϕ: $X \to Y$ to a space E in which X is dense. § B is devoted to basic preliminary results. We describe the largest subspace of E over which ϕ could possibly be extended, and give a description of the extension. In § C we apply these results to extensions to βX, the Stone-Čech compactification of X. We give an extremely simple proof of the fundamental theorems concerning βX and discuss several other problems in this area.

In § D we generalize to the case where E is not a subspace of βX, utilizing the results of §C systematically. We are able to describe precisely how far ϕ can be extended, both in terms of the relation of E to βX, and independently of βX.

In Chapters II and III, we are concerned with the following problem. Let ϕ be a continuous mapping of the completely regular space X into itself. Under what conditions can we find a space $\bar{X}$ with given properties (generally compactness), such that ϕ can be extended to a mapping from $\bar{X}$ into $\bar{X}$?

Chapter II is devoted to metric spaces. In §F, we find that a complete $\bar{X}$ can always be found over which a given countable set of mappings can be extended; indeed, $\bar{X}$ can be chosen to be homeomorphic to a subspace of the completion of X in any metric.

We then turn to the problem of finding a compact metrizable $\bar{X}$. We show in §G that if Φ is a countable set of continuous mappings from the separable metrizable space X into itself, then there is a metric compactification $\bar{X}$ of X over which all the mappings in Φ can be extended. If the mappings in Φ are homeomorphisms onto, then $\bar{X}$ can be chosen so that the extended mappings are also homeomorphisms onto. Various consequences of these results are discussed.

In § H, we discuss the problem of extending more than countably many mappings. This is in general not possible, but we are able to give necessary and sufficient conditions in terms of the manner in which the mappings act as a topological semigroup on X.

Chapter III generalizes the main results of Chapter II. Here we consider a completely regular space X of weight m, and a collection Φ of m continuous mappings from X into X, and we construct, in § K, a compact Hausdorff space $\bar{X}$ of weight m, over which all the mappings can be extended. (Such an $\bar{X}$ we call an m Φ-compactification.) Thus several of the results of Chapter II are special cases of these results, corresponding to $m = \aleph_0$. The methods are quite different, however. Here we use sophisticated results concerning completely regular spaces, including uniform structures and the Stone-Weierstrass Theorem.

We show in § L that if $|\Phi| = n$ is greater than m, the weight of X, then X has an m Φ-compactification only when Φ acts "nicely" on X. We can always find an n Φ-compactification, by our methods, but in the presence of the continuum hypothesis, βX fills this role quite adequately as we show in §M. Microfilm $2.50; Xerox $4.00. 72 pages.

A CW-DECOMPOSITION OF THE SYMMETRIC PRODUCT OF SPHERES

(L. C. Card No. Mic 59-3120)

Bert Mendelson, Ph.D.
Columbia University, 1959

The n-cube, I^n, with boundary, $\dot{I}^n$, shrunk to a point s_0 is an n-sphere, S^n. A point $x \in S^n - \{s_0\}$ is written $x = (t_1, \ldots, t_n)$, $(t_1, \ldots, t_n) \in I^n - \dot{I}^n$. The points of $S^n - \{s_0\}$ may be linearly ordered in terms of their coordinates. A point $z = (z_1, \ldots, z_k)$ in the k-fold Cartesian product, $\Pi(k, S^n)$ of S^n such that $z_j \neq s_0$, $j = 1, \ldots, k$, possesses an order type given by a sequence $q = (i_1, \ldots, i_{k-1})$ of integers chosen from $\{0, 1, \ldots, n\}$ and an element α in the symmetric group G_k on k letters. The set of all points of order type given by q and α form a cell of dimension $N_n(q) = n + i_1 + \ldots + i_{k-1}$. Thus, utilizing the various embeddings of $\Pi(k-1, S^n)$ into $\Pi(k, S^n)$, one obtains a cell decomposition of $\Pi(k, S^n)$ such that the elements of G_k, acting on $\Pi(k, S^n)$ by permuting coordinates, carry cells into cells, and inducing a cell structure on the orbit or identification space, $SP(k, S^n)$, called the k-fold symmetric product of S^n. The cells of $SP(k, S^n)$, denoted by $[n;q]$, are specified uniquely by sequences of length less than k (including the empty sequence) of integers chosen from $\{0, 1, \ldots, n\}$. The cell $[n;q]$ is of dimension $N_n(q)$ and its boundary lies in cells of lower dimension, thus yielding a CW complex.

The homology boundary of a cell $[n;q]$ is calculated in terms of functions of the sequence q. For $n \geq 2$, the subgroup C′ of the integral chain group of $SP(k, S^n)$ generated by cells $[n;q]$ such that $q = (i_1, \ldots, i_{k-1})$ and $2 \leq i_j$, $j = 1, \ldots, k-1$, is a subcomplex. The remaining cells generate a subcomplex C* whose homology is isomorphic to the homology of $SP(k-1, S^n)$ via the homomorphism induced by the embedding of $SP(k-1, S^n)$ into $SP(k, S^n)$. Thus the CW structure yields the direct sum decomposition

$$H(SP(k, S^n)) \approx H(SP(k, S^n), SP(k-1, S^n)) + H(SP(k-1, S^n)) .$$

The subcomplex C′ is decomposed further. Let r be an integer, $1 \leq r \leq n/2$. Let $J(n;k;r)$ denote the subgroup of C′ generated by cells $[n;q]$ such that q is a sequence of integers chosen from $\{2r, 2r+1, \ldots, n\}$ and at least one of the two integers 2r or 2r+1 occurs in q. Then $J(n;k;r)$ is a subcomplex of C′ and

$$C' = J(n;k;1) + \ldots + J(n;k;[n/2])$$

is a direct sum decomposition, where $[n/2]$ is the largest integer less than or equal to $n/2$. Furthermore $J(n;k;r)$ is chain isomorphic to $J(n+2;k;r+1)$. This isomorphism is induced by the function

$$[n;(i_1, \ldots, i_{k-1})] \to [n+2;(i_1+2, \ldots, i_{k-1}+2)] ,$$

which raises dimension by 2k. Thus we obtain a direct sum representation

$$H(SP(k, S^n), SP(k-1, S^n)) \approx H(J(n;k;1)) + H(J(n-2;k;1) + \ldots + H(J(n-2([n/2]);k;1)$$

$H(SP(4, S^n)$ is calculated explicitly.

Let $\omega_{r,t}$ denote the chain mapping induced by the natural mapping

$$SP(r, S^n) \times SP(t, S^n) \rightarrow SP(r+t, S^n) .$$

$\omega_{r,t}([n;q_1] \times [n;q_2])$ is also calculated.

Microfilm $2.50; Xerox $6.00. 124 pages.

GENERALIZATIONS OF SOME THEOREMS ON POSITIVE MATRICES TO COMPLETELY CONTINUOUS LINEAR OPERATORS IN A NORMED LINEAR SPACE

(L. C. Card No. Mic 59-5567)

Ancel Clyde Mewborn, Ph.D.
The University of North Carolina, 1959

Supervisor: Alfred T. Brauer

A well known theorem of O. Perron and G. Frobenius states that a positive n-square matrix has a positive characteristic root which is greater than the modulus of each other root and to which corresponds a positive characteristic vector. In 1940 M. A. Rutman generalized this theorem to a class of completely continuous linear operators in a complete normed linear space. In this paper the following results of Frobenius are generalized to the setting given by Rutman. Let A be a positive matrix with maximal characteristic root r. Then (1) if $s > r$ the matrix $[sI-A]^{-1}$ is positive, and (2) if B is a principal minor matrix of A with maximal characteristic root q then $q < r$. A generalization is also given of the result of L. Collatz that if x is a positive vector then Ax-rx has at least one non-negative coordinate and at least one non-positive coordinate.

A necessary and sufficient condition that a type of partially ordered normed linear space be lattice ordered is given in terms of the existence of certain positively order bounded operators in the space.

Microfilm $2.50; Xerox $3.00. 40 pages.

REGULAR FUNCTIONS ASSOCIATED WITH CONVEX SETS

(L. C. Card No. Mic 59-6439)

Henry Conrad Miller, Jr., Ph.D.
The University of North Carolina, 1959

Supervisor: J. S. MacNerney

The classical notion of a Stieltjes transform [see H. S. Wall, Analytic Theory of Continued Fractions, p. 247] is extended to that of a Stieltjes transform relative to a closed, unbounded, convex body of complex numbers with connected complement and with the boundary as the path of integration. Some asymptotic properties and an inversion theorem analogous to those of the classical Stieltjes transform [see J. S. MacNerney, "Half-bounded matrices," Journal of the Indian Mathematical Society, vol. 16 (1952), p. 159] are obtained. Necessary conditions are found in certain inequalities which arise in the paper of MacNerney [ibid., p. 154] in connection with reciprocals of infinite matrices associated with convex sets. Some properties of functions satisfying these conditions are developed. Finally, the case of a wedge-shaped convex body is investigated and necessary and sufficient conditions are found.

Microfilm $2.50; Xerox $3.00. 35 pages.

ANALYTIC THEORY OF CONTINUOUS TRANSFORMATIONS

(L. C. Card No. Mic 59-6501)

Togo Nishiura, Ph.D.
Purdue University, 1959

Major Professor: Lamberto Cesari

This thesis concerns the partial extension of the theory of surface area for continuous mappings from certain subsets of E_k into E_n.

The first extensions deal with the theory of Geŏcze area. The Geŏcze "k-area" for continuous mappings from subsets of Euclidean k-space E_k into Euclidean n-space E_n, $n \geq k \geq 2$, is defined and treated in a manner parallel to the definition and treatment of Cesari's book Surface Area. The corresponding definitions and theorems for the k-dimensional case can be made provided the definitions of a k-dimensional polyhedral region and, in particular, a "simple" k-dimensional polyhedral region are suitably defined. In Chapter I of the thesis, precise definitions are given for polyhedral regions and simple polyhedral regions. "Flat" mappings, i.e., when k = n, are studied in Chapter II, and the corresponding results of the book Surface Area (k = n = 2) are almost entirely extended.

To perform the parallel development of the theory of Geŏcze k-area for continuous mappings from subsets of E_k into E_n, $2 \leq k < n$, it is necessary to define a "cylindrical" property for such mappings. This property plays an important part in proving that the Geŏcze k-area is a limit with respect to a certain index of "fineness." It is known that for k = 2 and n = 3 the finiteness of the Geŏcze 2-area has very strong implications on the cylindrical property. In Chapter III, it is proved that for k = 2 and $n \geq 3$ the finiteness of the Geŏcze 2-area has the same implications on the cylindrical property. An example is given to show that for $3 \leq k < n$, the corresponding implications on the cylindrical property are no longer true when the Geŏcze k-area is finite. It is proved that, for $n > k \geq 3$, if the point-set covered by the continuous mapping in E_n has zero Hausdorff (k + 1)-measure then the desired control of the cylindrical property is attained.

It is shown in Chapter IV that, under the conditions that either k = 2 and the Geŏcze 2-area is finite or $k \geq 3$ and the point-set in E_n covered by the continuous mapping has zero Hausdorff (k + 1)-measure, the Geŏcze k-area is a

limit with respect to a certain index of fineness. This fact is of interest in light of the axiomatic theory of quasi-additive set functions. In this chapter, all necessary statements are proved to show that the Geŏcze k-area satisfies the axioms of quasi-additive set functions, provided the continuous mappings satisfy the above conditions. A consequence of the fact that the Geŏcze k-area is a quasi-additive set function is the existence of the Cesari-Weierstrass integral. Finally, in connection with the theory of quasi-additive set functions, it is shown that the Geŏcze k-area induces a measure on the domain of the continuous mapping provided the continuous mapping satisfies the conditions stated above.

To give the direct proof of the equality of the Lebesgue 2-area and the Geŏcze 2-area of continuous mappings (surfaces) from certain subsets of E_2 into E_3, Cesari proves that the Geŏcze 2-area is invariant under orthogonal linear transformations of E_3 onto itself. In Chapter V it is proved that the Geŏcze 2-area of continuous mappings from subsets of E_2 into E_n, $n \geq 3$, is also invariant under orthogonal linear transformations of E_n onto itself. Also, certain approximation theorems concerning the "tangential" properties of a continuous mapping from subsets of E_2 into E_3 with finite Geŏcze 2-area are proved.

The second extensions deal with the generalized length of a contour and the Cavalieri inequality. The concepts of generalized length of a contour and the Cavalieri inequality were first introduced by Cesari for continuous mappings from simple Jordan regions in the plane. R. E. Fullerton has extended these concepts to continuous mappings defined on compact 2-manifolds with or without boundary. In Chapter VI, the extension of the concept of generalized length of a contour for continuous mappings from open sets of the plane or sets open in a Jordan region, i.e., admissible sets, is made. This extension is made using the familiar invasion process. With this definition and the results of R. E. Fullerton, the Cavalieri inequality is then established for continuous mappings defined on admissible sets in the plane.

Microfilm $2.50; Xerox $7.20. 155 pages.

TESTS OF HYPOTHESES IN THE CASE OF UNEQUAL VARIANCES

(L. C. Card No. Mic 59-6502)

James Augustus Norton, Jr., Ph.D.
Purdue University, 1959

Major Professor: Carl F. Kossack

The principal motivation for this thesis is to provide the practicing statistician with methods for dealing with a situation that is met frequently in practice, but is not frequently discussed in Statistical textbooks, namely, testing the hypothesis of homogeneity of a set of parameters in the presence of heterogeneity of the error variances of their estimators. The following cases are dealt with: 1) single classifications, 2) main effects of fixed model double classifications, 3) main effects of fixed model multiple classifications of higher order, 4) individual comparisons, 5) interaction in fixed model double classifications, and 6) the two-level fixed main effect of r x 2 mixed model double classifications. For cases (1) through (4), a unified treatment is given, in which all tests are presented as special cases of a single theorem, where variances are known, approximately, as with certain stabilizing transformations, or as approximations thereto, in those cases in which the variance estimates are themselves random variables. Few of these results are really new, but many of them are scattered throughout the statistical literature, some in little-used references, so as to make them effectively unavailable in routine statistical practice. In the case of main effects of fixed model double and higher order multiple classifications, the point of view is presented that the research worker has the responsibility, and should be given the opportunity, to specify the composition of the "inference populations" to which he wishes to generalize, and to decide whether or not he wishes the estimation and test of any particular main effect to be independent of the other main effects in the design.

In the case of interaction in fixed model double classifications, it is shown that it is not possible to set down a single set of restrictions on the parameters of a linear model which permit this freedom of choice of composition of main effect inference populations, and at the same time conform to what the research worker wishes the hypothesis of zero interaction to mean. Thus, the test for interaction must be separate from, and is unaffected by, the choice of composition of the inference populations in the tests of the main effects. This amounts to the perhaps heretical point of view that slavish adherence to analyses based on a single linear model for the dependent variable is not always in the best interests of the research worker. With the interaction test separated from the main effects tests in this way, it is then shown that any choice of restrictions which yields the desired meaning for zero interaction leads to the same test procedure for the hypothesis of zero interaction.

For the two-level fixed main effect of r x 2 mixed model double classifications, the results of an extensive experimental sampling project are reported which indicate that if the standard errors of the row differences have a symmetric distribution, or a distribution skewed to the left, then the null hypothesis on the expected value of the row differences may be tested with the usual paired-differences t test, and the true sizes of critical regions will be well approximated by the appropriate Student t distribution. However, when the standard errors of the row differences have a distribution skewed to the right as much as the right half normal, then the Student t distribution will tend to overestimate the true size of tail regions of the distribution of the t statistic if the error variances of the observed row differences account for half or more of their actual variance over rows. The greater this ratio, and/or the smaller the number of rows in the test, the greater is the magnitude of this distortion. In the extreme, the true size of tail regions may be cut to as little as one-half of the nominal size indicated by the corresponding t distribution. Microfilm $2.50; Xerox $7.00. 148 pages.

MULTI-DIMENSIONAL INCOMPLETE BLOCK DESIGNS

(L. C. Card No. Mic 59-5573)

Richard Frederick Potthoff, Ph.D.
The University of North Carolina, 1959

Supervisor: S. N. Roy

Suppose we have m varieties of corn and n types of fertilizer which we want to experiment with, and let us assume that a completely homogeneous piece of land is available to us. Suppose we want to run an experiment with fewer than mn observations. Then the familiar incomplete block design, about which much has been written in the literature, is available for our use. Since this familiar incomplete block design involves two factors (corn and fertilizer), we may refer to it as a two-dimensional incomplete block (2DIB) design.

Suppose now, however, that we have m varieties of corn, n types of fertilizer, and p insecticides which we want to experiment with, and suppose that we want to run fewer than mnp observations. In this case we have three factors instead of two, and we will be seeking a three-dimensional incomplete block (3DIB) design, about which very little has appeared in the literature. A trivial special case of a 3DIB design, for example, is the familiar Latin square, for which m=n=p. The Youden square is a somewhat less trivial special case of a 3DIB design.

If we have four factors, we may speak of a 4DIB design, of which the Greco-Latin square happens to be a special case. In general, we may speak of multi-dimensional incomplete block (MDIB) designs.

Chapter I of the thesis deals with the analysis of MDIB designs under additive models (i.e., models with no interaction terms). Attention in this chapter and in succeeding chapters is focussed primarily on 3DIB and 4DIB designs. For 3DIB and 4DIB designs which satisfy certain restrictions, Chapter I shows how to obtain estimates of factor (treatment) contrasts and how to test the usual hypotheses of no effect.

Chapter II is concerned with the analysis of MDIB designs under interaction models. Again the various estimates and tests of hypotheses which would normally be desired are developed for designs satisfying certain restrictions. All possible types of 3DIB interaction models are covered, and some of the simpler 4DIB interaction models are considered.

Chapter III presents actual examples of designs which satisfy the restrictions under which the analyses of Chapters I and II were developed. A total of 38 designs, chosen mainly for their illustrative value, is presented; all of them are original except for several which originated as duplicate bridge movements. This third chapter also discusses certain aspects of the construction of MDIB designs.

Chapter IV deals with certain miscellaneous extensions of the theory of MDIB designs. Topics covered include the development of some matrix results which imply the impossibility of certain types of MDIB designs; variance components analysis for MDIB designs with additive models; and MDIB designs in multivariate analysis of variance. Microfilm $3.50; Xerox $11.80. 270 pages.

PLANE POTENTIAL FLOW PAST AN OBSTACLE IN A STRAIGHT CHANNEL

(L. C. Card No. Mic 59-5979)

Paul B. Richards, Ph.D.
Case Institute of Technology, 1959

A vortex sheet on the smooth contour of a two-dimensional obstacle is used to generate the complex velocity of the flow about the obstacle in a uniform stream within a straight channel of width h. A singular complex integral equation with Cauchy type kernel is derived for the complex velocity on the contour, and this equation yields a real Fredholm integral equation of the second kind for the (tangential) velocity on the contour. The kernel of this Fredholm equation is shown to be continuous on the contour for all $h > 0$, and yields, for $h = \infty$, the familiar Neumann kernel which arises in plane potential flow about an unconfined obstacle. The existence of a continuous solution of the Fredholm equation is established for h sufficiently large, and is strongly suggested for all $h > 0$. This solution is unique modulo an additive multiple of the circulation flow.

Solutions of the Fredholm equation are calculated for non-circulatory flow past the confined circle and ellipse, using the method of successive approximations. Results obtained are in excellent agreement with the doublet approximation for the circle, and with the finite difference solution for the ellipse, indicating that the method of successive approximations converges for shapes of practical interest. Microfilm $2.50; Xerox $4.40. 85 pages.

TWO-STAGE EXPERIMENTS FOR ESTIMATING A COMMON MEAN

(L. C. Card No. Mic 59-6444)

Donald L. Richter, Ph.D.
The University of North Carolina, 1959

Supervisor: Wassily Hoeffding

Let π_1, π_2 be two normal populations with common mean μ and variances σ_1^2, σ_2^2, where the parameter values are unknown. Suppose that it is desired to estimate μ; that the experimental procedure is to take a sample of size m from each population, compute variance estimates, and then take n-2m observations from that population with the apparently smaller variance; and that n is fixed beforehand. Let V_0 be the minimum possible variance and let $R_n(\theta,m) = (\mathrm{Var}\ \hat{\mu})/V_0$ be the risk of $\hat{\mu}$, where $\theta = \sigma_2^2/\sigma_1^2$. For a class of "best" estimators, it is shown that $\sup_\theta R_n(\theta,m) \to 1$ as $n \to \infty$ if and only if $m(n)/n \to 0$ and $m(n) \to \infty$ as $n \to \infty$; that $\min_m \max_\theta R_n(\theta,m) \sim 1 + Cn^{-1/3}$ as $n \to \infty$; and that the minimax sample size is $m(n) \sim Cn^{2/3}$ as $n \to \infty$. Microfilm $2.50; Xerox $3.00. 20 pages.

THE RESIDUE FIELD OF A LOCAL ALGEBRA

(L. C. Card No. Mic 59-5676)

Paul Theodore Rygg, Ph.D.
Iowa State University of Science and Technology, 1959

Supervisor: Dr. Bernard Vinograde

The problem dealt with is that of finding conditions under which the residue field of a local algebra R over a field K can be imbedded in R in such a way that the imbedded field contains K. It is not assumed that R is Noetherian, but only that N, the ideal of non-units, is such that $\bigcap_{i=1}^{\infty} N^i = (0)$.

The field K is assumed to have characteristic p ($\neq 0$) equal to the characteristic of the residue field R/N = F. The image of K under the natural homomorphism of R onto F is identified with K. It is also assumed that F is a pure inseparable extension of K with exponent over K.

In an investigation of the interrelationships of p-bases of F and K and a set, M, of generators of F oyer K, it is shown that $K \cap F^p = J$ is contained in $K^p(M^{p^{e_n}})$ in the case that F is of multiplicity n. The exponent e_n is the n-th canonical exponent of F in the sense of Pickert (Math. Zeit. 52: 81-136. 1949). A consequence is that J is contained in $K^{p^f}(G^{p^f}, M^{p^{e_n}})$, f an arbitrary positive integer. The set G is contained in a p-basis $Y = G \cup H$ of K such that K = J(G), $J = K^p(H)$. These, and other results, are used to give conditions under which $\bar{F}$, the image of F in R as obtained by Narita (J. Math. Soc. Japan 7: 435-443. 1955), contains K in the case that R is a primary local algebra.

Let R be a primary local algebra, λ the index of nilpotency of N. Let f_x be the exponent of x over K, x in M. Put $M^* = \{x^{p^{f_x}}\}$. It is shown that if $G \cup M^*$ contains a p-basis of K and G is p-independent in F, then there exists an $\bar{F}$ that contains K. The following are also sufficient conditions: H contained in $F^{p^h}(G, M^*)$, $p^h \geq \lambda$, and G p-independent in F. As a special case of this last result, if M consists of n elements then there exists an $\bar{F}$ containing K if G is p-independent in F and $p^{e_n} \geq \lambda$.

Microfilm $2.50; Xerox $3.00. 49 pages.

MULTIVARIATE CLASSIFICATION WITH NORMAL ALTERNATIVES

(L. C. Card No. Mic 59-6513)

Richard Henry Shaw, Ph.D.
Purdue University, 1959

Major Professor: Carl F. Kossack

Classifying an individual, or group of individuals all assumed from the same population, into one of two possible completely specified and multivariate normal alternative populations is based on a general statistic satisfying the Neyman-Pearson criterion for a most powerful test of hypothesis, the minimax criterion, and minimizing the expected loss due to misclassification. The classification statistic has one single value even though there may be m individuals in the group, each with p variates. Classification depends upon the magnitude of the statistic, whether or not it falls in a critical region defined by the parameters of the alternative distributions, the size of the critical region and the number of individuals in the group to be classified.

Since the distribution of the classification statistic is needed to determine its critical region, the characteristic function (c.f.), and consequently the moments, of the exact probability density function (p.d.f.) for the classification statistic is determined generally. The c.f. yields the exact p.d.f. of the classification statistic under certain conditions. A simplification of the c.f. yields the approximate p.d.f. of the classification statistic for any m individuals, under more general conditions. The approximation yields (1) good results when p = 1, (2) a general expression for the p.d.f. when m is even, (3) the exact p.d.f. for the classification statistic when the respective means of the alternatives are equal. Several different approximate methods are compared with the exact by using them to determine critical regions when p = 1. The rather common practice of assuming that the alternative covariances are equal reveals itself to be not very robust when the covariances are, in reality, not equal.

Applications of classification statistics are considered. A method for simplifying multivariate classification by reducing the number of variates is suggested and used in an industrial example of classifying bombsight computers as acceptable or not. Finally recommendations are offered toward the further development of classification techniques. Microfilm $2.60; Xerox $9.00. 197 pages.

ON COMPLEX TAUBERIAN THEOREMS

(L. C. Card No. Mic 59-6074)

Lee Suyemoto, Ph.D.
University of Cincinnati, 1959

P. Fatou in 1906 proved that from the regularity at z = 1 of a function $f(z) = \sum_{n=0}^{\infty} a_n z^n$, $|z| < 1$, along with the coefficient condition $a_n = o(1)$ one can assert the convergence of the series $\sum_{n=0}^{\infty} a_n$. M. Riesz in 1911 gave another proof of this fact and also proved that from the regularity at z = 1 of the function $f(z) = \sum_{n=0}^{\infty} a_n z^n$, $|z| < 1$, and the coefficient condition $a_n = o(n^{\alpha})$, one can conclude that $\sum_{n=0}^{\infty} a_n$ is Cesaro summable of order α, $\alpha \geq 0$.

An analogous Fatou theorem where one can assert absolute convergence, that is, the regularity at z = 1 of $f(z) = \sum_{n=0}^{\infty} a_n z^n$, $|z| < 1$, and $a_n = a(1)$, where $a(1)$ means $\sum_{n=0}^{\infty} |a_n - a_{n-1}|$ converges, implies that $\sum_{n=0}^{\infty} |a_n|$ converges has been proved in recent years (1953) by Jurkat and Peyerimhoff. These same two authors (1954) have extended the theorem to absolute Cesaro summability of order α, $\alpha > -1$, of the series $\sum_{n=0}^{\infty} a_n$, where absolute Cesaro summability means $\sum_{n=0}^{\infty} |\alpha_n|$ converges, $\alpha_0 = a_0$,

$$\alpha_n = \frac{1}{n A_n^{\alpha}} \sum_{v=1}^{n} A_{n-v}^{\alpha-1} v a_v, \quad n \geq 1, \quad A_n^{\alpha} = \binom{n+\alpha}{n}.$$

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The coefficient condition for the absolute Cesaro summability case is $a_n = a(n^\alpha)$, $\alpha \geq -1$.

In this dissertation two different proofs of the Fatou theorem for ordinary Cesaro summability is given, along with a different proof of the Fatou theorem for absolute Cesaro summability, order $\alpha \geq 0$. Finally a Fatou theorem for ordinary Riesz summability, order α, $0 < \alpha < 1$, and type $\lambda_n = \log n$ is proved.

Microfilm $2.50; Xerox $3.00. 41 pages.

THE SINGLE PROCESS LAW: A STUDY IN NONLINEAR REGRESSION.

(L. C. Card No. Mic 59-6571)

Malcolm Elijah Turner, Jr., Ph.D.
North Carolina State College, 1959

Supervisors: Robert James Monroe and
Henry Laurence Lucas, Jr.

Some important differences between linear and nonlinear regression models are described using a geometric device, due to R. A. Fisher, of representing all possible samples as points in an n-dimensional observation space. For illustrative purposes the two-dimensional case is considered in some detail. Differences between the classes of models noted are (1) orthogonality of sums of squares (represented as square distances), (2) distribution of sums of squares, (3) existence of sufficient statistics. Essentially nonlinear models (i.e., those not capable of being linearized) are characterized by non-orthogonality, unusual distribution of sums of squares, and unavailability of sufficient statistics. It is pointed out that essentially nonlinear models are most often encountered in science and should therefore be given due consideration. Attempts to study the properties of these nonlinear models are hampered by the fact that although there is only one kind of linear model there is an infinite variety of nonlinear ones and hence there is a need for the definition of classes of nonlinear models. The most interesting ones will have simply interpretable differential equations since the power of description of these latter is greater. An interesting family is given by the expression $y = \alpha + \beta(x - \gamma\delta)^\delta + \epsilon$ which arises from the differential equation $d\eta/d\xi = \delta(\eta - \alpha)/(\xi - \gamma\delta)$. Since by taking δ to be various values we obtain special processes such as the "exponential process," "linear process," "parabolic process," "inverse-square process," etc. The name single process law is suggested for the generic model. After a discussion of analytic properties of the special cases certain statistical problems concerned with discriminating the special cases are taken up. Computational schemata for obtaining maximum likelihood estimates and asymptotic confidence limits are set out. In order to illustrate the model-building potential of the single process law, as well as to illustrate the estimation procedure, an original theory of middle and long-distance track records is sketched and numerically fitted to the world records for 1957. It is concluded that "the excess of average speed over the asymptotic value is inversely proportional to the $3/7^{th}$ power of the time of the race." It is possible that the asymptotic confidence limits will not be satisfactory for small samples. Three exact tests of significance and their associated confidence limits are described. It is thought that one of these, the parabolic test, has not been recorded previously and that this test may prove to be useful. Application to the track record example has been made. Review of some important results in linear path regression is made in order to conveniently extend the results to the nonlinear situation in which the single process law describes each connection in the causal network. Computational methods are described which are simple generalizations of the univariate techniques. The surprising fact is brought out that problems of identification are the same in the linear case and in the particular nonlinear case studied and for this reason certain estimation algorithms are also valid for the nonlinear system. A sampling investigation has been carried out in the univariate situation in order to explore the properties of the maximum likelihood estimates of the indicial or exponential parameter δ. In particular, comparison of the finite variances and the asymptotic ones have been made so as to judge the adequacy of the asymptotic methods. It appears that, with a 2% or smaller coefficient of variation at the center of the curve and with at least ten equidistantly spaced observations, we may trust the large sample techniques. Larger rates of error will not permit resolution of the special forms of the single process law and hence are of little practical interest to the model-builder. Brief presentations of a cubic approximation valid for large $\gamma\delta$ and a simplified estimator based upon a finite difference approximation for the derivative are given in the appendices. Microfilm $2.50; Xerox $4.60. 88 pages.

THERMODYNAMIC PROPERTIES OF A DISORDERED LATTICE

(L. C. Card No. Mic 59-3027)

George Herbert Weiss, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Elliott W. Montroll

In this thesis we present a method for evaluating thermodynamic properties of a disordered lattice which can be expressed as additive functions of the normal mode frequencies. The genesis of the method is the representation of the additive function as a contour integral. A logarithm appears in the integrand which can be expanded to give a power-series representation for the additive function in terms of a suitable perturbation parameter. An earlier calculation by Prigogine, Bingen and Jeener yielded a perturbation expansion for the zero-point energy under more restrictive assumptions than are contained here. We are able to give a far more general and rigorous discussion of the problem because the mathematical justification for our expansion reduces to the study of the permissibility of expanding the logarithm appearing in the integrand. This question can be resolved with the aid of a theorem due to Gerschgorin which yields bounds on the eigenvalues of a matrix. In particular, our results reduce to those given by Prigogine et al. for the zero-point energy when certain conditions on the masses of the constituent atoms are fulfilled. In other cases it is found that the procedure given by these authors can be incorrect.

We apply our general computational techniques to the particular case of a two-component lattice, in which the mass of the j'th component is denoted by M_j. A mass of M_1 is allowed to be on any lattice site with probability p and a mass of M_2 with probability 1-p. We give the most detailed calculations for the zero point energy since this is the easiest function to study. It appears that an evaluation of the change in the average frequency spectrum cannot be found by our method unless all of the terms of the series that arises can be found and summed. We have succeeded in doing this approximately only for the case when M_1 differs by a very small amount from M_2. However, we show that our partial results in the general case which represent the additions to the average frequency spectrum by delta functions and derivatives of delta functions can be used to find correction terms to other additive functions. In particular this method is applied to finding correction terms to the expression for the specific heat.

Microfilm $2.50; Xerox $4.20. 79 pages.

MUSIC

CONCERT PIECE FOR ORCHESTRA AND SEXTET FOR WOODWINDS AND PIANO

(L. C. Card No. Mic 59-5704)

Arthur Russell Custer, Ph.D.
State University of Iowa, 1959

Chairman: Professor Philip Bezanson

CONCERT PIECE FOR ORCHESTRA is a one-movement work with the following instrumentation:

Two flutes
second doubling piccolo
Two oboes
Two Bb clarinets
second doubling bass clarinet
Two bassoons

Four F horns
Two C trumpets
Two tenor trombones
One bass trombone
One tuba

Three timpani (one player)
Percussion (three players)
snare drum, bass drum, cymbals, triangle, wood block, xylophone, bells

Strings

Structurally, the piece falls into three large sections, the first and third being linked thematically. The A section is made up of three theme areas which are greatly contrasting in mood and character. The first is bold and fanfare-like (Allegro; ♩ = 116), the second light and playful (Piu Mosso; ♩ = 132, measure 25), and the third lyric (Meno; ♩ = 120, measure 45). The climax of the last is terminated by the introduction of the fanfare idea (measure 106), the dissolution of which leads to a short after-development of the second theme (measure 139). A codetta (measure 149) brings the first section to a close at measure 167.

The B section, which is expository rather than developmental, is in itself a ternary structure, and introduces two new theme groups. The first is broad and sustained (♩ = 108, measure 176), the second soloistic and somewhat more rhythmic (measure 202). A transitional section leads directly to the recapitulation (measure 259). The fanfare idea is followed by a $\frac{6}{8}$ version of the second theme (measure 283). The lyrical third theme group, considerably shortened, is culminated by a closing section which introduces the coda at measure 337. The coda is based on an augmented version of the fanfare tune.

The texture is predominantly contrapuntal throughout, with two and three-part counterpoint most frequently employed.

The tonal organization is decidedly fluid. In fact the goals which define the structure tend to be melodic rather than tonal, the melodic climaxes generally being accompanied by tones which deliberately avoid any tonal focussing.

Virtuoso writing is generally avoided, since it was the composer's desire to produce a work in which rhythmic interest and vitality were important stylistic features, and which would at the same time be susceptible to performance by non-professional orchestras with a minimum of rehearsal time.

SEXTET FOR WOODWINDS AND PIANO is a three-movement work for woodwind quintet (flute, oboe, clarinet, horn, bassoon) and piano. The movements are thematically linked through the cyclical use of material from the first movement. It is a virtuosic piece of approximately fifteen minutes duration, written in serial technique.

The tone-row, a twelve-note series, is used more as a point of departure than as a rigid technical straight jacket, and is abandoned frequently at those points where its use would tend to restrain a natural impulse in a certain direction.

In the first movement (Sinfonia), a slow introduction precedes the main tempo, where the complete series is exposed in the opening unison (measure 26). After the lyrical second theme (measure 86), a modified version of the original returns "alla burleska." The coda (measure 175) is based on the initial first theme motive.

The second theme of the Sinfonia provides the principal melodic interest in the slow movement (Cantilena), since it serves both the opening and closing sections, framing the contrasting theme group (measure 40) which serves as the middle section of the over-all ternary design.

The third movement (Finale), is cast in a kind of

sonata-allegro form in which the second theme is not recapitulated. Noteworthy is the long development section (measure 53) in which a considerable portion of the introduction to the first movement is literally quoted.

Microfilm $2.50; Xerox $6.20. 127 pages.

EXPRESSION FOR ORCHESTRA AND VARIATIONS FOR STRING QUARTET

(L. C. Card No. Mic 59-5710)

Richard James Felciano, Ph.D.
State University of Iowa, 1959

Chairman: Professor Philip Bezanson

The thesis consists of a one-movement symphonic work, Expression for Orchestra, and a set of Variations for String Quartet.

The symphonic work is scored for standard orchestra with woodwinds in pairs, four horns, three trumpets, three trombones, tuba, percussion (including harp), and the usual complement of strings. The piece is in ternary form, ABA, with the recapitulated A section being largely developmental in character. Harmonically, the work fluctuates between tonality and modality, with the use of dissonance being governed by few factors other than the composer's aesthetic sense, which, after all, was always the final arbiter even in periods when definite rules were applied to such use.

The principal theme is subjected to various rhythmic and melodic transformations in the course of the work, especially in the final section where it is employed in a fugue, every entrance of which is a variation of a previous entrance. The "head" of the theme is also given extensive motivic development in the course of the outer sections of the work.

The center section is composed of contrasting material and displays a more quiet and reposeful nature than the two outer sections.

The Variations for String Quartet are admittedly influenced by the works of Anton Webern, especially in their extreme concentration of expression, their tightly woven texture, their clarity, and their brevity. Not only are all of the melodic and harmonic materials employed derived from the row, but the rhythmic materials, as well, are thence derived by means of numerical intervalic relationships inherent in the series itself. The row employed exhibits several interior symmetries: tones 7 through 12 form the retrograde inversion of tones 1 through 6; tones 4, 5, and 6 form the inversion of tones 1, 2, and 3; tones 7, 8, and 9 form the retrograde of tones 1, 2, and 3; tones 10, 11, and 12 form the retrograde inversion of tones 1, 2, and 3.

The first variation makes extensive use of the rhythmic relationships 3:1 and 1:3 (both derived from the row), occasionally with the latter relationship in values different from those of the former.

The second variation is a figural one, based on the col legno motif which is introduced in the final measure of the preceding variation. There is continued use of the 3:1 and 1:3 rhythmic relationships.

The third variation is based on measures 39 and 40 of the previous variation and on the first three intervalic relationships of the row, that is 3:1:1.

The rhythmic relationships of the theme groups of the fourth variation are derived from the melodic intervals found between the four symmetrical trichords of which the row is composed (1:3:1). The trichords themselves are exploited in the accompaniment figure of three equal values.

The fifth variation features a canon at the octave between the second violin and the violoncello which is based on the 3:1 and 1:3 relationships of measures 3 and 4 of the first variation.

In the final variation, while the violoncello plays an augmentation of the opening motif of the first variation, the three other instruments present a rapid counterpoint based on the accompaniment figure of the fourth variation.

Microfilm $2.50; Xerox $5.00. 98 pages.

ITALIAN KEYBOARD MUSIC IN THE INTERIM BETWEEN FRESCOBALDI AND PASQUINI [AND] MUSICAL SUPPLEMENT

(L. C. Card No. Mic 59-6440)

James Frank Monroe, Ph.D.
The University of North Carolina, 1959

Supervisor: William S. Newman

This dissertation deals with one manuscript and nine published sources of seventeenth-century Italian keyboard music dating between 1635 and 1700. Eighteen Italians known to have been active within this period are represented in the sources, as follows: G. C. Arresti, Bassani, Luigi Battiferri, Franceso Boerio, Gioanpietro Del Buono, Cherli, Donato Cimino, Colonna, Antonio Croci, Giovanbattista Fasolo, Fabritio Fontana, Monari, Pollaroli, Michel Angelo Rossi, Giovanni Salvatore, Bernardo Storace, Gregorio Strozzi, and Ziani.

In Chapters I-III the sources and their contents are discussed in general. Chapters IV-VI contain a discussion of structural organization and style traits, supported by 114 musical examples and ten statistical tables. In addition, a Musical Supplement contains facsimiles of title pages and score excerpts, translations of prefaces, and transcriptions of representative pieces from the sources.

On the whole, the compositions found in the ten sources represent a transitional stage in the history of Italian keyboard music. The composers represented merely carry on the traditions of Merulo, Cavazzoni, Frescobaldi, and other Italian predecessors. Their importance in the history of keyboard music per se rests chiefly on the fact that their ricercars formed the working ground for the eighteenth-century keyboard fugue, while their toccatas, variations, and dance compositions contributed toward the development of idiomatic keyboard music in general.

Microfilm $3.75; Xerox $12.80. 292 pages.

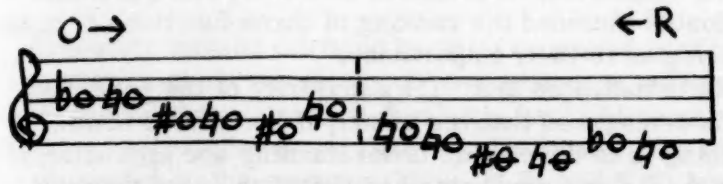
VARIATIONS FOR VIOLIN, OBOE, BASSOON AND PIANO AND CONCERTO FOR CHAMBER ORCHESTRA.

(L. C. Card No. Mic 59-5733)

Horace Judah Reisberg, Ph.D.
State University of Iowa, 1959

Chairman: Associate Professor Philip Bezanson

VARIATIONS FOR VIOLIN, OBOE, BASSOON AND PIANO is a work based on a rather strict application of the twelve-tone method of composition. All the important pitch relations are derived from the following fundamental twelve-tone series:



The intervals used are minor seconds and minor thirds, with one major third between notes six and seven. Each succeeding trichord is a variation of the first one. This close relationship of elements can be compared to the kind of row favored by Anton Webern. The composer admits the importance of the influence of that great master in the development of this composition and in the CONCERTO FOR CHAMBER ORCHESTRA.

The formal structure of the VARIATIONS is basically symmetrical, being centered by the fifth variation, the slowest and longest one. The theme and four variations come before the pivotal center, and four variations and the coda after it. There are approximate correspondences of tempo and musical material between theme and coda, first and ninth variations, second and eighth, and so on.

Retrogression, as a structural principle, is important in a large part of the work. The theme, first variation and eighth variation do not utilize this technique. However, variations two, three, five, seven and nine are halved, with their second halves being varied retrogrades of their respective first parts. Variation six is a retrograde of the fourth variation. The coda is built with a combined forward and retrograde treatment of the theme.

The performance time is approximately seven minutes.

CONCERTO FOR CHAMBER ORCHESTRA is a composition in two movements played consecutively by means of an overlap between the first and second.

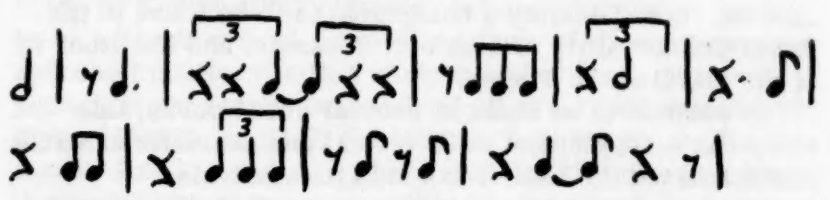
The title does not refer to the concept of the solo concerto, or the concerto grosso. Its meaning is closest to the concerto idea of Bartók, as in his Concerto for Orchestra. Bartók envisioned the orchestra, in that work, as a group of components, each of which was capable of being soloistic in nature, either singly, or in concert with like components. The present writer extends this concept to one in which all instruments are completely equal in value, their choice of usage being dependent only upon their fitness to state an individual musical idea.

CONCERTO FOR CHAMBER ORCHESTRA, like the VARIATIONS, is based on a twelve-tone pitch series. It will be noticed that notes ten, eleven and twelve are an inversion of one, two and three. This fact was used, in great part, to determine the choice of transpositions. It made,



in effect, a nine tone row, notes ten, eleven and twelve of one row functioning also as notes one, two and three of another.

The second movement begins with an introduction of twenty-eight measures. From measure twenty-nine to the end, another series, consisting of ten rhythmic units, is combined with the pitch series of twelve tones. The original rhythmic series is as follows:



These rhythmic components were chosen and derived from the introductory material of the movement. They were then used as the basis of a four-part rhythmic canon. The canonic structure is broken only rarely. At times the rhythm series is varied through use of related figurations. It is also varied by an augmentation (twice as long) and a diminution (one-half the time value of the original).

The two movements of the concerto are decidedly contrasting in character. The first does not use either the rhythm series or the canonic principle of structure. It is much quieter than the second, depending on instrumental color a great deal, and rising above mezzo-forte only in measures thirty-seven through forty-one.

The predominant use of muted strings and muted brass contributes to the subdued quality. Another factor is the lack of percussion instruments, their use being restricted to the second movement.

The performance time is approximately eleven minutes. Microfilm $2.50; Xerox $4.60. 90 pages.

BENEDETTO MARCELLO'S CHAMBER CANTATAS

(L. C. Card No. Mic 59-6448)

Caroline O. Sites, Ph.D.
The University of North Carolina, 1959

Supervisor: Glen Haydon

Benedetto Marcello, Venetian nobleman (1686-1739), left nearly 400 works in the field of vocal chamber music, a much greater number than heretofor surmised. Three hundred of these are cantatas for solo voice with basso continuo (274) or with continuo and strings (27). Included in the list of secular vocal works are 73 duets, 8 trios, 3 quartets, 1 quintet, and 6 works in a classification designated as serenatas.

The cantatas for solo voice comprise the major portion of Marcello's output in the field, and all but a few remain unpublished. The manuscripts are preserved in

Italian libraries and in such sources outside Italy as Berlin, Vienna, Munich, Münster, Brussels, and London. The major repositories for the music are La Biblioteca Nazionale Marciana in Venice; La Biblioteca del Conservatorio di Musica "Luigi Cherubini" in Florence; La Biblioteca Comunale del Conservatorio musicale "G.B. Martini" in Bologna; and the British Museum in London.

Although very few manuscripts are dated, it is likely that the solo cantatas were composed in the 22-year period from 1703 (the earliest date appearing in one manuscript from the S. Pietro a Majella Conservatory library in Naples) to 1725. The last two secular works of which we have any record were composed in 1727 and 1729. There are only two manuscripts presently available that bear the exact date of the day, month, and year for each cantata. One (possibly a holograph) is to be found in the Royal Conservatory of Music in Brussels, and the other is at the Marciana in Venice.

In addition to an index of secular vocal works, this study has a supplement of 22 lyrical and dramatic cantatas that furnished the basis for a stylistic analysis.

Da capo arias are employed almost exclusively, with occasional ariette that are monothematic. In the former, the B section cadences most often in the key of the dominant, the relative minor, or in the relative minor of the dominant. Transient modulations to nearly-related keys are characteristic of both recitatives and arias, with successive seventh chords and enharmonic key shifts occurring more often in recitatives.

As in the Neapolitan and Venetian cantatas of Marcello's contemporaries, and in the Italian cantatas of Handel, arias often begin with a short introduction played by the continuo (or by the continuo and strings), which usually anticipates the thematic material of the solo part. The basso continuo, often treated as an ordinary bass and serving as a second voice part, is sometimes written as a quasi-ostinato bass. Many manuscripts have the continuo partially realized.

Marcello's recitatives make use of the standard melodic and cadential formulas employed by most composers of the early 18th century. Although the bass recitatives have some wide leaps, the melodies in both recitative and aria are always vocally conceived and in the arias, are sequential in style.

Individualistic traits are manifested in Marcello's predilection for notational mannerisms and for enharmonic modulations. Notational devices include enharmonic notation employed in one aria from the dramatic cantata, La Magia and in all of La Stravaganza, and proportional time signatures used in both these cantatas.

Microfilm $2.50; Xerox $6.40. 132 pages.

A FOLLOW-UP STUDY OF MUSIC EDUCATION AT NORTH TEXAS STATE COLLEGE

(L. C. Card No. Mic 59-5964)

William Marion Turner, Ed.D.
North Texas State College, 1959

This investigation was concerned with the preparation of music teachers at North Texas State College for performing activities involved in teaching music in the public schools. The problem was attacked through three subordinate problems: (1) determination of activities in teaching music; (2) ratings by a panel as to the importance of the activities; and (3) an analysis of the opinions of eighty-one graduates who teach or have taught music as to the adequacy of their undergraduate preparation for performing these activities. The study covered the period from 1946 through 1955.

Sources of data included published and unpublished material on music teaching and suggestions from experienced teachers. One hundred forty-nine activities were selected and classified into three main categories: (1) instrumental, (2) vocal and (3) general music. Subdivisions under each included: "skill," "aesthetic," "adjustment and guidance," "administrative" and "public relations" activities. Opinions were obtained from graduates with regard to their preparation in 143 activities considered important by the panel. Additional information obtained from panel and graduates included the ranking of three functions of music teaching as to their importance.

Data indicated that: (1) a majority of the panel and graduates agreed that the principal function of music teaching is to develop an understanding and appreciation of music; (2) forty graduates had taught in more than one area of music; (3) about one half had taught non-music subjects; (4) activities in teaching skills and aesthetics were rated important by larger percentages of the panel than were other activities; (5) relatively high percentages of the panel rated activities concerned with administration and adjustment and guidance as important; (6) activities involved in public relations and management were rated important by smaller percentages of the panel than were other activities; (7) in general, the percentages of graduates indicating adequate preparation were more uniform and higher in all three divisions of music teaching for activities in teaching music skills and aesthetics; (8) fewer graduates indicated preparation for activities involved in management in instrumental than in vocal or general music; (9) relatively low percentages of graduates indicated adequate preparation for activities in administration and adjustment and guidance in all three divisions of music teaching; (1) general music teachers in greater numbers than in other divisions indicated lack of preparation for activities involved in public relations.

Conclusions were: (1) prospective music teachers need skills in teaching an understanding and appreciation of music; (2) preparation in more than one area of music might contribute to the prospective music teacher's success; (3) preparedness to teach in non-music areas also might aid the music major's teaching effectiveness; (4) the findings suggest that sufficient emphasis has been placed on the preparation of teachers to perform activities needed in teaching music skills and aesthetics; (5) certain activities in teaching skills and aesthetics, however, appear to need more emphasis; (6) apparently, the graduates did not receive sufficient understanding of psychology and its application in teaching music; (7) the findings suggest the need for improved preparation for the practical tasks involved in administering the music program; (8) improved preparation for activities involved in relating the music program to the community is indicated; (9) apparently there is need for more emphasis in the development of skills in writing and speaking.

The findings suggest that less effective preparation is being given prospective music teachers for activities which depend upon competence in non-music areas than for those related to music knowledge and skills.

Microfilm $2.50; Xerox $7.00. 150 pages.

A STUDY OF CENTRAL NERVOUS SYSTEM BARRIERS USING TRITIATED BARBITAL

(L. C. Card No. Mic 59-6470)

Charles Ralph Boshart, Ph.D.
Purdue University, 1959

Major Professor: George K. W. Yim

Randomly labeled tritiated barbital was used in this investigation to study the ability of physostigmine, acetazolamide and methazolamide to facilitate barbital penetration from the cerebrospinal fluid into the brain. The study was prompted by the reports (Greig, M.E. and T.C. Mayberry, J. Pharmacol. Exptl. Therap., 102, 1(1951); Kerley, T.L., Ph.D. Thesis, Purdue University, 1958) that two of these agents alter blood-brain barrier permeability to barbital.

The tritiated compound was purified prior to use. Labile tritium was removed by repeated equilibration with water. Impurities were removed by recrystallization to constant specific activity from ethanol-water and toluene solvents followed by liquid-liquid column partition chromatography. Purity of the product was shown by the presence of a single radioactive spot after paper chromatography and by regression analysis of variance (Baggett, B. and L.L. Engel, J. Biol. Chem., 229, 443 (1957)). Initial specific activity of 282 mc/g was reduced to approximately 252 mc/g in the purification steps. An insignificant loss of activity was found for barbital-t isolated from the serum of a rabbit.

Acetazolamide, methazolamide and physostigmine were tested for their ability to alter barbital penetration from cerebrospinal fluid into brain. The "modifier" drugs were administered to rats 30 minutes prior to injection of tritiated barbital (8 μc) intracisternally. The animals were sacrificed 5 minutes after barbital-t injection and brain and blood levels were determined. The drug treated and control groups were as follows:

A. No Drug Control: Saline, 0.85%, intraperitoneally

B. Acetazolamide: 200 mg/kg, subcutaneously

C. Methazolamide: 100 mg/kg, subcutaneously

D. Drug Control: CL-13,850: 100 mg/kg, subcutaneously

E. Physostigmine Salicylate: 0.8 mg/kg, intraperitoneally

A randomized block experimental design was used. Barbital-t brain and blood level data were subjected to the analysis of variance.

No significant difference in brain or blood barbital-t levels was observed between control and "modifier" pretreated animals. Cholinesterase inhibition by physostigmine and carbonic anhydrase inhibition by acetazolamide and methazolamide apparently were not effective in facilitating barbital penetration into brain from cerebrospinal fluid. The results with physostigmine were surprising in view of the report by Greig and Carter (Arch. Biochem. Biophys., 52, 175 (1954)) that physostigmine enhanced barbital penetration into brain slices in vitro. If acetazolamide acted to alter blood-brain barrier permeability in the study by Kerley (Ph.D. Thesis, Purdue University, 1958) by an alteration in blood pH the effects of the carbonic anhydrase inhibitors in this study would not have been expected, since cerebrospinal fluid pH is altered little by the drugs (Birzis, L., C.H. Carter and T.H. Maren, J. Pharmacol. Exptl. Therap., 122, 6A(1958)). If a change within the brain tissue was responsible for the blood-brain barrier alteration observed by Kerley, then the action of all three modifiers employed in this study may have been masked by the pial membrane.

Microfilm $2.50; Xerox $5.40. 109 pages.

A MEASUREMENT OF THE EFFICIENCY OF OINTMENT BASES IN RELEASING A LOCAL ANESTHETIC BY USING A PAIN THRESHOLD METHOD

(L. C. Card No. Mic 59-6625)

Eugene William Brockemeyer, Ph.D.
The Ohio State University, 1954

The introduction of numerous formulas for ointment bases during the past few decades has given the physician a wide choice of bases from which to choose. Previously the physician's selection was limited to the grease bases. As a result, the physician centered most of his attention on the medicament and its efficiency and put very little thought into the selection of a proper base for the medicament.

Generally speaking, most investigators are of the belief that the vehicle exerts a marked effect on the penetration of medicaments through the skin, although some investigators think that the nature of the penetrating substance rather than the vehicle may be the determining factor. There is no good evidence that the ointment base acts as a vehicle to carry the substances through the skin. Aside from its ability to place the penetrating substance into more intimate contact with the skin, the vehicle must be able to part with the substance and not "hold" it; otherwise penetration may actually be obstructed. This situation, which has received consideration from a number of investigators, may account for some of the apparent differences among ointment bases.

There are several methods reported in the literature for evaluating the efficiency of ointment bases. Most of these methods are designed to measure the absorption of bactericidal and fungicidal agents, antibiotics, hormones,

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vitamins, dyes, alkaloids, various poisons, inorganic salts, and radioactive tracer compounds from various ointment bases. However, up until a few years ago there was no method reported in the literature to measure the efficiency of absorption of local anesthetics from ointment bases other than clinical trial. The work of Christensen and Tye[1] on analgetics and, later, the work of Mack, Nelson, and Guth[2] and Lucas and Guth[3] suggested a pain threshold method utilizing a modified Hardy-Wolff-Goodell pain threshold apparatus for the evaluation of ointment bases containing local anesthetics.

The purpose of the study was twofold. First, an investigation was made to ascertain the possibilities of determining the depth and length of anesthesia produced by various ointments containing a local anesthetic when applied to the tail of a rat by using a modification of the method suggested by previous investigators. Secondly, a study was made to determine if it is possible to make a correlation between the percutaneous absorption of a local anesthetic from the tail of a rat and from normal human skin.

The Hardy-Wolff-Goodell pain threshold apparatus as modified by Tye in his work with analgetics was employed. It consists of a 500-watt lamp, the light beam from which is focused by a condensing lens to an aperture. A variac transformer was used to replace the original rheostat in order to control the intensity. The intensity of the radiation is indicated on a dial in millicalories per second per square centimeter by a sensitive voltmeter. Any desired interval of time for the stimulus to be applied is made possible by a shutter which is electronically controlled and a timer. In order to prevent any heating by conduction of the metal tube between the lens and the aperture, cold water was continuously passed through a coil of copper tubing which was wound around the length of the metal tube. Also, a piece of asbestos tape was placed beneath the shutter to deaden the noise, since the shutter formerly closed with a loud click which could have disturbed or conditioned the animals by its sound.

The local anesthetic used in this study was selected arbitrarily because the purpose of the investigation was to secure information concerning the efficiency of ointment bases, not of any particular local anesthetic. Surfacaine (Cyclomethycaine Sulfate) was chosen as the local anesthetic to be used throughout the study.

The ointment bases selected for this study were chosen in order to have a representative from each of the following types of bases: an all grease base, a w/o emulsion base, an o/w emulsion base, a water soluble base, and a fat-free, water-washable base.

White Ointment U.S.P. XIV was chosen to represent the all grease base. As representatives of the emulsion bases, Surfacaine Ointment, manufactured by Eli Lilly and Company, was selected to represent the w/o base; and Hydrophilic Ointment U.S.P. XIV was selected to represent the o/w base. Polyethylene Glycol Ointment U.S.P. XIV was picked to represent the water soluble base. Volclay Bentonite Base and Hydrogen Bentonite Base were chosen to represent the fat-free, water-washable base. By including the bentonite bases, the writer hoped to supplement further the information already obtained by the laboratories of the College of Pharmacy at The Ohio State University on the efficiency of ointment bases containing bentonite as a major component.

The albino rat was selected as the laboratory animal to be used in this study. The posterior third of the tail was used as the test area. Daily handling of the rats for several weeks provided an animal that was quiet and convenient with which to work. In order to keep as many factors constant as possible, all albino rats used in this investigation were males and of the same strain (C. F. Wistar). The rats weighed between 100 and 200 g. at the beginning of the investigation. Feeding of the animals was kept uniform and the animals were housed throughout the investigation in an animal room in which the humidity and temperature were maintained as constant as possible.

The back of the human hand was chosen as the test area for the second part of this study to determine if it is possible to make a correlation between the percutaneous absorption of Surfacaine from the tail of a rat and from normal human skin. This area was very convenient for applying the ointment and it was an area that was convenient for measuring pain threshold. Also, the number of hair follicles and sebaceous glands present in the skin on the back of the hand should be comparable to that found in the skin of a rat's tail. The back side of both the left and right hands were used in order to expedite the testing.

The results obtained strongly substantiate the common belief that ointment bases do not possess the same degree of efficiency in releasing an incorporated medicament to the surrounding tissues. The ability of the six bases used in this study to release Surfacaine varied widely. Hydrogen Bentonite Base was found to be the most efficient base while White Ointment was found to be the least efficient.

The three ointments which were prepared from bases containing water produced a greater degree of local anesthesia in the rat's tail than the three ointments prepared from bases containing no water. These results appear to be in agreement with the numerous reports that the rate of release of a medicament from a base is greatly influenced by the solubility of the medicament in the external phase of the base. However, it can be concluded from the results that the percentage of water in a base is not the sole determinant in the rate of release of Surfacaine, since Hydrogen Bentonite Base, which contains 55 per cent water, was slightly more efficient than Volclay Bentonite Base which contains 70 per cent water.

The depth and duration of local anesthesia produced by the bentonite ointments was very remarkable. A greater depth of anesthesia might have been produced by these ointments than indicated by the experimental results, since it was impossible to obtain a positive response with many of the rats when the maximum stimulus possible with the Hardy-Wolff-Goodell apparatus was applied. The maximum stimulus that could be applied with this apparatus was 450 mc./sec./cm.^{2}. When one takes into account that previous investigators[2,3] considered 350 mc./sec./cm.^{2} to represent a highly satisfactory degree of local anesthesia, the results obtained with the bentonite ointments are even more outstanding.

In order to get a true measurement of the depth of anesthesia produced by the bentonite bases, one would need to decrease the concentration of Surfacaine in these ointments. However, the object of this research was to make a direct comparison between the efficiency of the various ointment bases. The concentration of the Surfacaine in the bentonite ointments could not be decreased since a 5 per cent concentration of Surfacaine was necessary in the less efficient bases in order to obtain a measurement of the release of Surfacaine.

It was found that Volclay Bentonite Ointment after

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standing from 5 to 10 days not only releases the Surfacaine more slowly but in a lesser amount than when the ointment is freshly prepared. However, the age of Hydrogen Bentonite Ointment has no effect on the depth and duration of local anesthesia produced by this ointment. No attempt was made to find out why the release of the Surfacaine from Volclay Bentonite Ointment when freshly prepared varies with that after it stands from 5 to 10 days. Perhaps the Surfacaine had undergone cationic exchange with the Volclay Bentonite Base upon standing, since it is known that the cations of bentonite may be replaced by organic cations as well as inorganic cations. Although Hydrogen Bentonite Ointment produced the same depth and duration of anesthesia after standing from 5 to 10 days as it did when it was freshly prepared, it is still possible that some degree of cationic exchange between the Surfacaine ion and the hydrogen ion took place.

If the Surfacaine did undergo cationic exchange with the Volclay Bentonite Base, it appears from the results that the exchange took place rather slowly and not upon immediate contact of the Surfacaine with the base since the pH of the ointment had changed only 0.05 of a pH unit after it had stood for 1 day and 0.35 after it had stood for 5 days.

The finding that Hydrogen Bentonite Base was slightly superior to Volclay Bentonite Base is substantiated by the results of Barr and Guth[4] and Lucas and Guth.[3] Barr and Guth[4] reported that sulfathiazole, ammoniated mercury, and phenol showed greater antibacterial activity when incorporated into Hydrogen Bentonite Base than when incorporated into Volclay Bentonite Base. Lucas and Guth,[3] in their study of ointment base efficiency, found that Hydrogen Bentonite Base was more efficient in releasing butacaine sulfate and ethyl aminobenzoate than Volclay Bentonite Base.

The controls run with the various ointments showed that Hydrophilic Ointment, Polyethylene Glycol Ointment, and the bentonite bases produced no significant elevation in pain threshold. However, a significant rise in pain threshold was observed when White Ointment was used as a control. It is believed that the elevation in pain threshold produced by the White Ointment is caused by the grease base preventing somewhat the coating ability of the water soluble India ink when applied to the rat's tail. Therefore, some of the radiant heat would be reflected from the tail, and a higher quantity of radiant heat would have to be applied in order to have the same amount of heat absorbed than when determining the normal pain threshold.

Since a control base for the Surfaçaine Ointment was not available, the results obtained with this ointment are believed to be somewhat high because Surfacaine Ointment is also a grease base. It should be noted, however, that since Surfacaine Ointment is a Hydrophilic Petrolatum base, a better coating of the rat's tail with the water soluble India ink was possible than with the White Ointment.

The failure of the Surfacaine to produce any local anesthesia when applied to the back side of the human hand may be expected since it is generally agreed that local anesthetics cannot penetrate normal, healthy human skin. Although the Surfacaine did not produce any local anesthesia in the human subjects, one must take into account that during clinical application Surfacaine is usually applied to injured or diseased areas. The absorption through these areas is vastly different from the absorption through healthy intact skin. Therefore, it appears that injured or diseased skin must be used if one is to measure the efficiency of ointment bases containing Surfacaine on human subjects.

Although no correlation was found between the percutaneous absorption of Surfacaine from the tail of a rat and that from normal human skin, valuable information on the efficiency of ointment bases can be obtained by using the rat's tail as a test area.

It is believed that the best procedure for measuring the rate of release of local anesthetics from ointment bases is to determine the elevation in pain threshold produced by the ointment containing the local anesthetic after being in contact with the test area for varying lengths of time. One disadvantage in using this procedure in screening ointment bases is the time factor.

Although the elevation in pain threshold produced by the various ointments did not vary significantly in the animals used, an additional number of animals would have to be run to validate the results reported. The time factor of this procedure should not preclude its use in making a more intense study on different phases of the investigation.

From the results reported in the dissertation, the following conclusions appear to be in order.

1. The bentonite bases are more efficient in releasing Surfacaine than are Hydrophilic Ointment, Polyethylene Glycol Ointment, White Ointment, and Surfacaine Ointment.

2. The bentonite bases not only give a rapid release of Surfacaine but also a continuous release of Surfacaine for 4 hours.

3. The Hydrogen Bentonite Base is slightly more efficient in releasing Surfacaine than Volclay Bentonite Base when each base is freshly prepared.

4. Ageing the Volclay Bentonite Ointment from 5 to 10 days decreases the depth of local anesthesia produced by this ointment.

5. Ageing the Hydrogen Bentonite Ointment from 5 to 10 days does not decrease the depth or duration of local anesthesia produced by this ointment.

6. The addition of Surfacaine to the bentonite bases produces a significant lowering in their pH.

7. Surfacaine is more rapidly released from ointment bases that contain water.

8. The percentage of water present in the ointment bases is not the sole determinant in regulating the rate of release of Surfacaine.

9. The rate of release of Surfacaine from Polyethylene Glycol Ointment more nearly approximates the rate of release of Surfacaine from grease ointment bases than from ointment bases containing water.

10. White Ointment is inefficient in releasing Surfacaine.

11. Five per cent Surfacaine in either Hydrophilic Ointment or Hydrogen Bentonite Base is ineffective in producing local anesthesia when applied to the back side of the human hand.

12. No correlation was found to exist between the percutaneous absorption of Surfacaine from the tail of a rat and from normal, healthy human skin.

13. The efficiency of ointment bases in releasing a local anesthetic can be determined by using a modification of the Hardy-Wolff-Goodell pain threshold apparatus.

Microfilm $2.50; Xerox $5.20. 102 pages.

1. Christensen, B. V., and Tye, A. "The Determination of Analgetic Potency by a Quantal Method," J. Am. Pharm. Assoc., 40 (1951), pp. 404-05.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

2. Mack, W. L., Nelson, J. W., and Guth, E. P. "A New Technique for the Evaluation of Ointment Bases," J. Am. Pharm. Assoc., 42 (1953), pp. 116-17.

3. Lucas, W., and Guth, E. P. "A Comparative Analysis of Ointment Base Efficiency Utilizing a Pain Threshold Method," J. Am. Pharm. Assoc., 42 (1953), pp. 344-46.

4. Barr, M., and Guth, E. P. "Cation-Saturated Bentonites as Constituents of Ointment Bases," J. Am. Pharm. Assoc., 40 (1951), p. 13.

Abstract published by special arrangement with The Ohio State University.

AN EXPERIMENTAL STUDY OF THE PARTICIPATION OF THE SYMPATHETIC NERVOUS SYSTEM IN THE LYSERGIC ACID DIETHYLAMIDE (LSD) REACTION IN CATS

(L. C. Card No. Mic 59-5459)

John Thompson Elder, Jr., Ph.D.
University of Washington, 1959

Chairman: James M. Dille

The LSD-induced "rage" phenomenon in cats has been described and various drugs and surgical procedures used in an attempt to antagonize this reaction. Of the drugs used as antagonists, only chlorpromazine and dibenzyline were effective. Atropine, scopolamine, hexamethonium and hydralazine had no significant effect on this reaction. Adrenal demedullation and complete surgical sympathectomy were also ineffective in altering the behavioral response to LSD. Reserpine appeared to intensify most of the responses to stimuli, but shortened the duration of the reaction. In the reserpine treated animals, a catatonic-like state developed about one hour after LSD and persisted for up to 48 hours.

Because of the efficacy of chlorpromazine and dibenzyline, both of which have antiadrenergic properties, it is proposed that LSD exerts its action upon central sympathetic areas. Microfilm $2.50; Xerox $4.00. 71 pages.

THE EFFECTS OF TWO ISOMERIC AMINOAZOTOLUENES ON THE TOTAL NON-PROTEIN SULFHYDRYL AND GLYCOGEN CONTENTS OF RAT LIVER

(L. C. Card No. Mic 59-6499)

Ivan Theodore Myers, Ph.D.
Purdue University, 1959

Major Professor: Tom S. Miya

Of the many means available by which cancer can be experimentally produced in the laboratory animal, the aminoazo dyes have been widely used as carcinogenic agents. Among the many compounds that have been evaluated in the rat, the hepatocarcinogenicity of o-aminoazotoluene (o-AAT) has been repeatedly verified, while p-aminoazotoluene (p-AAT) has been shown to be devoid of carcinogenic activity. In order to differentiate between the biochemical alterations which might be solely related to the detoxification of such compounds and those which might be related to the induction of hepatomas, these two agents were selected for comparison in this study.

Each compound was incorporated in both a normal and a low (8%) protein-low riboflavin diet at a concentration of 0.06%. The mixtures were fed to female albino rats (Holtzman), and control animals were maintained on the basal diets alone. In addition, an acute experiment was performed in which each compound was administered orally at a dose of 150 mg./Kg.

At various intervals of time, animals were selected at random from each group and were sacrificed so that the hepatic concentrations of total non-protein sulfhydryl (TNPSH) and glycogen could be determined. All liver samples were obtained from the right lappet of the median lobe, and portions of the same lobe were subjected to histopathological study. TNPSH was determined by an amperometric titration procedure, and the glucose liberated upon hydrolysis of the recovered glycogen was determined by the Somogyi-Shaffer-Hartmann method.

The effect of diet on the TNPSH content of liver was marked, the hepatic concentration of the animals receiving the basal low protein-low riboflavin diet being about 1/3 that of the normal diet animals following 20 weeks of feeding. There did not appear to be any additional alteration in liver TNPSH following the chronic ingestion of either of the aminoazotoluenes, or following their acute administration.

The livers of control animals being fed the low protein-low riboflavin diet contained more glycogen than those receiving the normal diet, this being attributed to the high (78%) carbohydrate content of the former. Neither compound when administered in an acute dose had a significant effect on glycogen. Chronic administration resulted in the glycogen contents of both treated low protein-low riboflavin groups being decreased after 10 weeks of feeding. This effect was more pronounced in the p-AAT group, and was also obtained in the normal diet-p-AAT animals at this interval of time. At 32 weeks, however, all animals were within their control ranges.

The absence of any aminoazotoluene-induced alteration in TNPSH cannot be considered conclusive, since several possible explanations exist: 1) the depletion of non-protein sulfhydryl by aminoazo dyes (e.g., by p-dimethylaminoazobenzene) may not be directly involved in their ultimate carcinogenic effects; 2) p-AAT may exert its hepatocarcinogenic action by a mechanism different from that of other aminoazo dyes; 3) although hepatic damage was produced, the effect of o-AAT when fed to the female Holtzman rat at a level of 0.06% may not be great enough to be manifested in a typical preneoplastic biochemical alteration.

The unexpected effect of p-AAT on hepatic glycogen would seem to indicate that glycogen depletion is not necessarily involved in the aminoazo dye-induced changes which result in neoplastic growth.

Microfilm $2.50; Xerox $4.60. 89 pages.

FREEZE-DRYING AS A PROCESS OF CURING PLANT DRUGS AS IT AFFECTS EXTRACTION OF ACTIVE INGREDIENTS

(L. C. Card No. Mic 59-6637)

Ella Blanche Sommers, Ph.D.
The Ohio State University, 1954

All living plants contain water. This medium is necessary for all chemical and physical reactions associated with life. Plants when harvested are subject to spoilage by a number of causes: (A) Bacteria and molds may attack many components in the plant tissue. These organisms, however, do not thrive except in the presence of an optimum amount of water. (B) All living protoplasm contains enzymes. These enzymes can cause plant constituents to be altered so as to create changes in their pharmacological action. Sometimes these changes are desirable but most often are considered undesirable.

Chambers and Nelson[1] have shown that freeze-drying as a process of curing plant drugs is applicable to the leaves of belladonna. Cosgrove and Guth[2] have shown that freeze-drying has a marked effect on digitalis leaves. It is the purpose of the present investigation to find how freeze-drying affects the plant drug in regard to its extraction. The extraction of the medicinally active ingredients is of major interest; however, inert ingredients must also be considered since these substances constitute a large part of extractable material in crude drugs. These inert ingredients may affect the extraction of the active principles of the drug.

The leaves of the Atropa belladonna plant were chosen for the present investigation because their alkaloids are important to pharmacy, and because they are readily available from the pharmaceutical drug gardens of The Ohio State University.

Freeze-Drying

Freeze-drying, the method of desiccation used in the investigation, has been applied by a number of investigators[3,4] as a method of preserving biological products. Its first application to crude drugs was carried out by Chambers and Nelson[1] and Rubin and Harris[5] in the pharmaceutical research laboratories of The Ohio State University.

Freeze-drying is the process of drying a substance or mixture of substances under a high vacuum while in the frozen state. The process is commonly called lyophilization. It is of particular note to the subsequent extraction processes that with freeze-drying[6] the solute remains evenly dispersed without undergoing concentration. Minimal coagulation occurs and the resulting product should be free from case hardening.

Enzymatic Action

Bonner[7] pointed out that cellular metabolism consists essentially in the chemical alteration of substrate molecules by reactions which take place to an extent only in the presence of enzymes. It is reasonable to assume that after the plant is harvested the processes that occur in the tissues are not immediately stopped.[8] Temperature, however, definitely affects the rate of an enzymatic reaction, and, in most instances, enzymes will be inactivated at temperatures near or below freezing point. It seemed evident, then, that freeze-drying should affect the extraction phenomena of a crude drug in a different manner than oven-drying.

Experimental

Collection

Belladonna leaves were collected on July 6 and on August 15, 1952, from the pharmaceutical drug gardens of The Ohio State University. They were combined and used in the first part of the study. More were collected on July 14 and on August 18, 1953. They were combined and used for the remainder of the investigation. Those gathered in 1952 were called Lot Number One, and they were used for the alkaloidal and total extractives determinations. Those gathered in 1953 were called Lot Number Two, and they were used for the nitrogen, sugar, and chlorophyll determinations.

The leaves were gathered in small quantities, and alternate portions were frozen with dry ice so that chemical changes would be retarded.

Drying

The frozen leaves were lyophilized in the Stokes Model 2004-L Freeze-Dryer. The lowest temperature recorded in the drying process was -40° C. and the lowest pressure was 200 microns. The time required was approximately twelve hours. The highest temperature recorded was 35°C.

The unfrozen leaves were dried in a Stokes Drying Oven, model 38-B, thermostatically controlled at 50° C. for thirty-six hours.

Determination of Powder Size

The July and August crops of the over-dried leaves were thoroughly mixed and reduced to a powder in the Wiley Mill. The powder was processed to sizes 20, 40, and 60 as described in the United States Pharmacopoeia XIV. The lyophilized leaves were treated in the same manner. The powders were stored in tightly closed containers in a dark cool place until they could be studied. They were protected against moisture by the use of "Drierite" in suitable containers.

Moisture Determination

The powders were assayed for moisture content according to the methods of the United States Pharmacopoeia. Moisture content was consistently higher in the lyophilized samples; however, the variation was not great.

Total Ash and Acid-Insoluble Ash

The powders were then assayed for total ash and acid-insoluble ash content according to the methods of the United States Pharmacopoeia XIV. They were found to be within the specified limits.

Alkaloidal Determination of the Percolate Fractions

Five successive 100 cc. fractional percolates were collected from a 50 gram sample of each powder size of the oven-dried and lyophilized material. This procedure was performed in triplicate on Lot Number One and Lot Number Two with the use of a menstruum consisting of 3 volumes of alcohol and 1 volume of water. Each of the percolates of Lot Number One were assayed for alkaloidal content according to the method specified for Belladonna Leaf Fluid extract by the National Formulary IX.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm.
Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The percolates of the lyophilized material possessed a slightly greater alkaloidal content when compared with the corresponding oven-dried samples; however, the increase was insignificant. It is possible that the assumption that there is an enzyme present using the alkaloids as a substrate is erroneous, or it may be true that the reactions concerned proceeded so slowly that the results were not detectable.

The rate of extraction of the alkaloids from the lyophilized powder was approximately the same as that found for the oven-dried material. Since the lyophilized material was not subjected to the degree of heat that the oven-dried material experienced, it seemed logical to expect a more rapid rate of extraction.

The alkaloidal content of the percolates of the lyophilized material decreased with increasing fineness of the powders used in their preparation. This could have been caused by the increased adsorption of the alkaloids resulting from increased surface area of the powders.

Total Alkaloids

Oven-dried and lyophilized powders Number 20, 40, and 60 were assayed for alkaloidal content by the United States Pharmacopoeia XIV method. The results compared favorably with those obtained in the "Alkaloidal Determination of the Percolate Fractions."

Total Extractives of the Percolate Fractions

The percolate fractions previously described were assayed for total extractive content according to the method specified in the United States Pharmacopoeia XIV. There was a significantly greater amount of solid extracted from the oven-dried material than from the corresponding lyophilized samples. It appeared from the behavior of the oven-dried material that the method of drying involved increased the solubility of certain cellular material in a hydro-alcoholic menstruum.

The total extractives increased with the increased fineness of the powder employed for the preparation of the percolates of the lyophilized material. This could be the result of the greater surface exposure of the powder.

The rates of extraction of the total extractives from the lyophilized samples were approximately the same as those for the corresponding oven-dried samples with the exception of the rate found for fraction one of powder size Number 40.

Total Extractives

Total extractives were determined by first exhausting 10 grams of each powder size by means of percolation with the same menstruum that was used for the fractional percolation and then proceeding as directed by the United States Pharmacopoeia XIV with the use of 25 cc. aliquots of the percolate. The results compared favorably with those obtained in the determination of "The Total Extractives of the Percolate Fractions."

Nitrogen Determination of the Percolate Fractions

The percolate fractions of Lot Two were assayed for nitrogen content. The method used was that of Lindner and Harley.[9] The results indicated that the oven-dried extracts contained a significantly greater extractable nitrogen content than the corresponding lyophilized extracts. This seemed to indicate that oven-drying at 50°C. caused a reaction to occur which increased the hydro-alcoholic soluble nitrogenous products. It has been shown that[1,10] proteolysis may occur during drying temperatures of 30°C. to 50°C.

The rate of extraction proved to be more rapid for powders Number 20 and 40 and less rapid for powder Number 60 of the lyophilized powders than for the corresponding oven-dried samples.

Total Nitrogen

The total nitrogen determinations were performed on percolates prepared in the same manner as those described in the case of the total extractives with the use of the Lindner Hartley method.[9] The results compared favorably with those obtained in the "Nitrogen Determinations of the Percolate Fractions."

Total Nitrogen in Powders

The nitrogen contents of the powders were determined by the Lindner and Harley method,[9] and they were found to be approximately the same. This was to be expected since the assays were performed directly on the powders and involved no preliminary extraction with a menstruum.

Sugar Determination of the Percolate Fractions

The sugar contents of the percolate fractions of Lot Two were determined by means of the Munsen and Walker method.[11] The percolates of the oven-dried material contained greater content of sugar than the corresponding lyophilized percolates. It seemed plausible that the oven-drying method could have altered the carbohydrates contained in the cells, causing them to be either more soluble or readily extracted.

The sugar content of the extracts of the percolates of the lyophilized material increased with the increased fineness of the powder used in their extraction. As in the instance of total extractives this could be caused by the increase of surface exposed to the menstruum.

Fractions 1 and 2 totaled showed a significantly greater rate of extraction for the oven-dried samples of the powders Number 40 and 60 than for the corresponding lyophilized samples; however, the same totals revealed a greater rate of extraction for the lyophilized samples of Number 20 powder than for the corresponding oven-dried samples.

Total Sugar

The determination of total sugar was performed on some of the percolate prepared for the total nitrogen determination. The Munsen and Walker method[11] was used. The results compared favorably with those obtained in the "Sugar Determination of the Percolate Fractions."

Total Chlorophyll

Chlorophyll determinations were performed on the oven-dried and lyophilized powders of belladonna leaves. The method used for the extraction of the chlorophyll was that of Comar and Zscheile.[12] Spectroscopic analysis for chlorophyll and its components was performed with the use of the Beckman D.U. Spectrophotometer.

Results of the determination indicated a significantly greater chlorophyll content for the lyophilized material than for the oven-dried material. It is probable that the freeze-drying process arrested the action of the enzyme chlorophyllase which is responsible for the hydrolysis of chlorophyll.

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The total chlorophyll content decreased with the increased fineness of the lyophilized powder used for the extraction.

The Rate of Chlorophyll Extraction

The method of Comar, Benne, and Buteyn[13] was used in the determination of the chlorophyll content of the percolate fractions. The measurements were made directly on the acetone extracts of the chlorophyll with the aid of a photoelectric calorimeter and prepared calibration curves. Freeze-drying facilitated the rate of extraction of the chlorophyll.

Conclusions

1. Freeze-drying as a process of curing plant drugs is as satisfactory as the process of oven-drying in regard to the extraction of the active ingredients.
2. The moisture content of the lyophilized material compares favorably with that found for the oven-dried material.
3. The alkaloidal content of the lyophilized material and the hydro-alcoholic extracts prepared from the lyophilized material is as great as that indicated for the corresponding samples of the oven-dried material.
4. Oven-drying as compared to freeze-drying significantly increases the amount of total extractives obtained with the hydro-alcoholic menstruum.
5. Oven-drying as compared to freeze-drying significantly increases the nitrogenous content of the hydro-alcoholic extracts.
6. The amount of carbohydrates extracted by the hydro-alcoholic menstruum from the lyophilized material is slightly less than that extracted from the oven-dried material.
7. It is possible that increased stability, increased esthetic values, and improved pharmacological activity, as a result of the increased stability, would be manifested by the hydro-alcoholic extracts of the lyophilized material because of their decreased nitrogenous and carbohydrate content. It is suggested that studies be carried out in regard to these aspects.
8. Lyophilization preserves more total chlorophyll, chlorophyll-a, and chlorophyll-b than freeze-drying.
9. Total extractives increase with the increased fineness of the lyophilized powder used for extraction.
10. Alkaloidal extraction decreased with the increased fineness of the lyophilized powder used for extraction.
11. In regard to the lyophilized material, the rate of the extraction of the total extractives is considerably more rapid than the rate of the extraction of the alkaloids except in the instance of the powder Number 60. Approximately the same phenomenon exists for the oven-dried material.
12. Freeze-drying facilitates the extraction of the chlorophyll.
13. Freeze-drying does not facilitate the rate of extraction of the alkaloids or the total extractives.
14. Freeze-drying facilitates the rate of extraction of the nitrogenous material except in the instance of powder Number 60.
15. Freeze-drying decreases the rate of extraction of the carbohydrates except in the instance of powder Number 20. Microfilm $2.50; Xerox $6.00. 121 pages.

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STUDIES OF THE IMMUNE RESPONSES ELICITED BY THE LUNGWORM PARASITE DICTYOCAULUS VIVIPARUS (BLOCH)

(L. C. Card No. Mic 59-6114)

Adelbert Elton Wade, Ph.D.
The University of Florida, 1959

Purpose. --This research project was designed to determine the nature of the immune response to Dictyocaulus viviparus infections, and to isolate an antigen that would stimulate the production of resistance to infection with this parasite. In order to facilitate this study an attempt was made to locate a relatively inexpensive and easily maintained laboratory animal, susceptible to lungworm infection.

Materials and Methods. --Varying numbers of infective larvae were administered to guinea pigs, rabbits, mice,

rats, hamsters, cats and goats. The degree of infection produced in each of these animals was determined. Hematological studies, complement fixation tests, and electrophoretic analyses of serums were conducted and the clinical signs resulting from initial infections in guinea pigs were observed. Responses as indicated by complement fixing antibody titers, serum components and effects on resistance to infections were studied in guinea pigs and rabbits following injections of whole worm, larva, lymph node, or lung exudate antigens. Antibody titer of serums were correlated with the onset of reinfection immunity in calves. Protective immunity afforded by injections of antigens in calves was evaluated.

Results. --Of the laboratory animals used in these experiments, the guinea pig and rabbit were found to be suitable hosts for immunological studies with the parasite D. viviparus. In guinea pigs infected with large doses of D. viviparus larvae increases in the gamma globulin component and complement fixing antibody titers of the serums were observed. The complement fixing antibody was noted in the serums of guinea pigs 15 days postinfection. Reinfection immunity in the guinea pig also was demonstrated. Antigens prepared from whole lungworms and third-stage larvae appeared to afford the greatest degree of resistance to lungworm infections in guinea pigs. An antigen prepared from mature lungworms plus larvae appeared to afford a significant degree of protection to lungworm infection in rabbits. Increased resistance to infection resulted from injecting whole worm-larva antigen into eight month old calves; however, in calves two to three months of age the resistance to infection afforded by injecting this antigen was less apparent. In both age groups the worms found at necropsy were significantly smaller in the principals than in the controls. Complement fixing antibody was observed 21 days after infection, and reinfection immunity sufficient to prevent the establishment of mature worms was observed to occur about 25 days following an initial infection in calves.

Conclusions. --The guinea pig was found to be a suitable laboratory animal for immunological studies involving D. viviparus. The whole worm-larva antigen, which appeared the most effective of those tested in providing protective immunity in laboratory animals, was shown to provide some protection to infection in calves over eight months of age. This vaccine was ineffective as an immunizing agent in three month old calves and failed to protect them from the resultant pathological changes and clinical signs produced by lungworm infection.

Microfilm $2.50; Xerox $8.00. 173 pages.

PHILOSOPHY

F. H. BRADLEY'S THEORY OF JUDGMENT: WITH SPECIAL REFERENCE TO THE PRINCIPLES OF LOGIC.

(L. C. Card No. Mic 59-5163)

John Howell Brown, Ph.D.
Princeton University, 1959

This dissertation aims at clarification of some of Bradley's main doctrines within what was known to 19th century philosophers as "theory of judgment"; and at critical appraisal of the most pertinent of these doctrines to contemporary problems of logic, language and knowledge. The introduction roughly defines the scope of idealist theories of judgment, compares them with more familiar theories and tries to remove some common misconceptions of what was meant by "judgment."

Chapter One deals with Bradley's definition, which appears in the Principles of Logic, of judgment as the reference of an "ideal content" to reality. The polemical inspiration of the definition and its supporting explanations; textual difficulties; criticisms of the definition by G.F. Stout, G.E. Moore and Cook Wilson; and Bradley's implied answers to those criticisms are discussed in that order. Objections were directed mainly at Bradley's characterization of "ideal content" as symbolized by or abstracted from a "psychical event." Charges of self-contradiction and circularity are disposed of by distinguishing between different sorts of symbols and kinds of abstraction, and by careful attention to Bradley's remarks on pre-judgmental cognition. Charges of inadequacy or empirical falsity are partly answered by introducing distinctions between levels of explicitness of judgments, between judgment and commitment, and between judgment as an ideal and judgment as practiced. But recourse to these defensive devices disperses the appearance of uniformity suggested by the original definition. The principal significance of the definition in Bradley's philosophy is asserted to consist (i) in providing general principles which guide analyses of various types of judgment (examples of which are given); and (ii) in suggesting to Bradley a defect or inadequacy which he claims is inherent in all judgment. The formulation of this defect in Appearance and Reality is presented and its intra-idealist polemical aspect identified and dismissed, leaving the claim of inadequacy for consideration in its own right.

Bradley's sceptical contention depends on his view of judgment as a "mental function," a view which seems to confuse the act and content of judgment, or what is asserted with the act of asserting. In this connection Moore's criticism from an extreme realist position is considered, and Bradley's reply constructed from his arguments against the conception (current in the 19th century) of judgment as the "union of ideas" and from his discussion of referring expressions. Independent examination of proper names and demonstratives leads to the conclusion that the distinction between act and content of singular referring statements is neither simple nor clear-cut, and that Bradley's refusal to separate them is not wholly indefensible.

In Chapter Three the alleged defectiveness of judgment is found to be localized in perceptual judgment, which is construed by Bradley as presupposing a view of perception

which assumes that complete description is in principle possible, and that certain sorts of components of perceptual descriptions are logically independent of each other. With this in mind, Bradley's argument against the "analytic judgment of sense" in the second chapter of the Principles of Logic is subjected to intensive scrutiny. Ambiguities are noted, certain segments of the argument rejected, and an interpretation provided for a substantial part of the argument which (i) preserves Bradley's protest against the empiricists' analysis of perception, (ii) disputes some basic claims of most sense-datum theories of perception, and (iii) leads to the conclusion that an exhaustive description of the given is strictly inconceivable.

Microfilm $5.70; Xerox $20.00. 446 pages.

A CRITICAL EXAMINATION OF SOME RECENT CONCEPTIONS OF THE NATURE OF METAPHYSICS

(L. C. Card No. Mic 59-5462)

Fred William Hagen, Ph.D.
University of Washington, 1959

Chairman: Paul Dietrichson

The subject of this thesis is certain current accounts of the nature of metaphysics. The author selects for special critical examination the accounts of Morris Lazerowitz and John Wisdom. An attempt is made to set forth clearly the nature of these accounts. Certain initial difficulties involved in these accounts are dealt with and similarities and crucial differences noted. An attempt is then made to apply these respective general accounts to the metaphysics of F. H. Bradley for the purpose of ascertaining just how serviceable these accounts are in assisting us to understand Bradley's work. The respective merits and demerits of these views are noted. The author concludes that Lazerowitz's view is fundamentally mistaken and that the view of Wisdom, although not clearly correct on all counts, is frequently of considerable aid in furthering our understanding of the origin of metaphysical problems and of the manner in which solutions to these problems are arrived at. The author makes some suggestions of his own concerning the nature of our difficulties in understanding metaphysical theories. These suggestions owe much to the works of the Austrian philosopher Ludwig Wittgenstein and are explained and supported by reference to the metaphysics of F. H. Bradley.

In his treatment of Bradley, the author was intent upon pointing out the intimate manner in which conceptual confusions are interrelated and paradox breeds paradox ad nauseam. Bradley's metaphysics is used to illustrate the drastic conceptual revisions which may be involved in a metaphysical system and to indicate that sometimes these conceptual revisions cannot be consistently carried out without ending in complete unintelligibility. Bradley's metaphysics serves to indicate the extent to which one finds logical, linguistic, and metaphysical theses involved in an intimate and bewildering interplay within a metaphysical system, each exerting a pressure upon the other in a quite tangled fashion. The author contends that it is possible to have conceptual investigations into problems of meaning and the uses of language without getting involved in metaphysics. The results of conceptual inquiry may be mistaken, but they cannot be impugned on the ground that they do not accord with some metaphysical theory. Only further inquiry into the workings of language can reveal the inadequacy of conceptual inquiry into the working logic of language. Metaphysics as one instance of a use to which language may be put is itself a quite proper object of conceptual inquiry. Metaphysical theories frequently condemn our understanding of the world because they rest on a misunderstanding of our linguistic practice. When this happens, metaphysics is not a use of language, but a misuse.

Microfilm $4.60; Xerox $15.40. 359 pages.

A METAPHYSICS OF BEAUTY

(L. C. Card No. Mic 59-4410)

Donald Arthur O'Grady, Ph.D.
University of Notre Dame, 1959

This work is a speculative metaphysical investigation of beauty from the point of view of an existential thomism.

The problem is whether and how beauty is consequent upon being.

Being is what is; the name "being" is given to a thing because it exists. In being existence is the total original actuality of the thing, in which essence limits, diversifies, unless there be a thing whose essence is its existence.

The transcendentals follow upon what is magis formale in being, existence. Every being is what it is; what it is is either a limiting essence or existence itself: being is "thing" (res). Multiplicity is evident in beings, but each being is undivided in the simplicity of its act of existence; being is one. In multiplicity there is distinction. Diversity is from limitation in being; difference, as consequent upon existence, is relational, not absolute. Distinction in relation is "other" (aliquid). Unity in relation, which retains otherness, is the relation of being and spirit, in intellect, the true, in will, the good. Ultimately, other, true and good are predicated intrinsically of every being in its relation to Infinite Being and Spirit.

The transcendentals are the primary names of being in its general modes, as distinguished from the special modes of limiting essence. The transcendentals are similar to logical properties, yet differ from the latter insofar as existence is not aform, and being and its passiones are identical in the thing, though significant for the meaning of being. Their basic division is from being considered in itself and in relation to another, viz., spirit.

The initial inductive study of beauty reveals the adequacy of traditional definitions of beauty. The problem of the ugly is similar to the problems of the true and false, good and evil. Beauty, from its definitions, includes being, one and the rest. Thus beauty is transcendental, but only, here, reductively and secondarily.

That beauty is a relational rather than absolute name of being is evident in experience and recognized the traditional definitions. The terms of the relation are being and spirit. Non-material elements in sensible being are form and existence. Form dominates being in sensible reality; but form as idea leads to spirit as the expressive non-dominating power of being, where spirit and being become other without loss of being, where being is present to itself.

Being, in its relations to spirit, through intellect and will, is named the true and the good. But because existence is primary and total actuality, and the principle of relation of being and spirit is existence, the primary relation of presence of being and spirit must be total. True and good express only partial relations; they cannot be the primary relation. Yet they remain primary names of being because intellect and will are pure perfections of spirit, distinct from one another, and from total relation. The composition of the good and the true cannot formally account for the total relation and presence of being because the whole is prior, not derived and secondary. Experience reveals the origin of love and knowledge is esthetic relation.

In summary, that which engenders total actual presence is beautiful; existence does so. Therefore, existence is beautiful, both Ipsum Esse Subsistens and habens esse. The first name of the existent is being; its second name is the beautiful. Microfilm $2.50; Xerox $6.00. 122 pages.

THE AESTHETIC OBJECT AND ITS RELATION TO AESTHETIC EXPERIENCE

(L. C. Card No. Mic 59-5477)

Benjamin Ross Tilghman, Ph.D.
University of Washington, 1959

Chairman: A. I. Melden

The purpose of the dissertation is to challenge the widely held theories that works of art are not, in certain important respects, at least, physical objects. Such theories are held because of three main considerations: (1) certain theories of epistemology and perception, (2) problems about the aesthetic expression of emotion, and (3) the special nature of works of literature.

The theory of S. C. Pepper is examined as an instance of the first consideration. Pepper holds that no physical objects can be directly perceived, thus no work of art as perceived can be a physical object. But his theory of perception with its attendant psychology does not allow us to distinguish between works of art and other objects and results in making the work of art a private object about which there can be no communication.

Virtually all aestheticians agree that art is expressive of emotion and most are agreed that emotional quality cannot characterize physical objects. Therefore, if art is to have emotional character works of art cannot be physical objects, but must consist, at least in part, of the artist's or observer's experiences and reactions. Unfortunately, such theories make the work of art into a private object about which we cannot communicate.

It has been generally recognized that works of literature cannot be identified with physical objects, but it is shown that neither can they be identified with a class of experiences or perceptions. The names of literary works do not serve primarily to name objects, rather they are always understood in linguistic contexts, e.g. "reading a poem," "writing a poem." Since poems are unlike paintings and statues in this respect the fact that they are not physical objects is no evidence for the status of other art objects.

There is considerable agreement that aesthetic experience involves at least three elements: (1) enjoyment, (2) disinterest, (3) awareness of emotional quality. Omitting literature the problem of how such experience is possible is the problem of how physical objects, i.e. paintings and statues, can have emotional character. In answering this question it is shown that emotion words do not refer simply to psycho-physical states, but have a wide range of uses. They are used to describe and evaluate character, behaviour, and situations, and to explain behaviour as well as to report or express feeling. A proper understanding of emotion shows it is possible to describe people, things, and situations in the language of emotion without actually having the emotion. To describe something in this way does not, as many philosophers have thought, depend on a special case of having the emotion.

Perceiving is shown to be a much wider concept than many philosophers have realized and that there is not a basic sense of "seeing" and that to see objects and emotional character is not a case of seeing simply shapes and colors amplified by other forms of experience. Objects can be seen in different ways. Aesthetic experience of a work of art is a special experience of the physical object and is not, as aestheticians have assumed, an experience of a special object. This special experience cannot be fully explained by the physiology of perception, but logically presupposes a familiarity with emotional concepts as used in everyday experience. The conclusion is reached that if emotion and perception are properly understood it is not necessary to suppose that the aesthetic experience of a painting is the experience of a special non-physical object, but that it is a special kind of experience of the public physical object.

Microfilm $3.60; Xerox $12.20. 277 pages.

PHYSICS, GENERAL

A STUDY OF THE MIGRATION AND DESORPTION OF A DIMORPHIC ADSORBATE USING THE FIELD EMISSION MICROSCOPE: TITANIUM ON TUNGSTEN.

(L. C. Card No. Mic 59-6291)

Robert Classie Abbott, Ph.D.
Syracuse University, 1959

Supervisor: J. W. Trischka

The migration and desorption of titanium on tungsten was measured by the field emission technique and the activation energies for these processes were determined. The method used was to measure the emission current as a function of heating time when a given amount of adsorbate migrated or desorbed from the tip at a given temperature. Because of the correspondence between degree of completion of migration or desorption and the degree of change in emission current, a characteristic time t(1/2) can be defined which represents the heating time necessary for the process to proceed half-way to completion and thus for half the total change in emission current to occur. This length of time, t(1/2), is related to the temperature T in the following way.

$$t(1/2) = t_o e^{E/kT}$$

Here t_o and k are constants and E represents the activation energy for the process to take place.

The experimentally determined relationships show that there is, at first, an increase in emission current during surface migration when the tip is heated, then a region is reached where further heating causes no change in current and, finally, with continued heating, the current increases again and eventually assumes a constant value representative of completed surface migration. This intermediate region, in the form of a plateau, separates the two regions of changing emission current and a characteristic time t(1/2) can be derived for both the early stage migration (before the plateau is reached) and for the later stage of migration. When these two sets of data are plotted as log[t(1/2)] versus (1/T), two corresponding values for the activation energy E can be obtained from the slopes of the plots.

The later stage of migration has an activation energy of 2.0 ± 0.1 ev. The early stage migration has two values of activation energy: 2.4 ± 0.1 ev above T = 847°C and 2.6 ± 0.2 ev below this temperature. The early stage characteristic time t(1/2) changes discontinuously at T = 847°C by a factor of 2.3. The desorption activation energy is 6.4 ± 0.2 ev.

It is postulated that the abrupt change in t(1/2) is caused by the excellent fit of the adsorbed titanium atoms to the b.c.c. structure of the tungsten substrate with a concurrent slight decrease in system free energy, when T > 847°C. Pure titanium transforms from h.c.p. to b.c.c. crystal structure at 883° C.

It is further postulated that the later stage migration occurs over a surface already partly smoothed, or covered, by the atoms chemisorbed during the early migration. This condition would cause the later stage migration activation energy to be less than the early stage, as observed.

Comparison of the estimated strengths for single Ti-Ti and Ti-W bonds with the experimental activation energy values indicates that, on the average, two Ti-W bonds are broken during early stage migration, while for the later stage of migration, one Ti-W and one Ti-Ti bond are broken. For desorption, four Ti-W and two Ti-Ti bonds are broken.

Microfilm $2.50; Xerox $3.80. 68 pages.

ELECTRON IRRADIATION OF INDIUM ANTIMONIDE AND INDIUM ARSENIDE

(L. C. Card No. Mic 59-5360)

Lee William Aukerman, Ph.D.
Purdue University, 1958

Major Professor: K. Lark-Horovitz

Bombardment of a solid with energetic particles such as electrons, alpha-particles, neutrons, or deuterons produces vacancies and interstitials which act as imperfections in the crystal structure. The electrical properties of semiconductors, being quite sensitive to such imperfections, afford a natural means of studying these defects.

The present work is concerned with the effect of electron bombardment on the electrical properties (Hall effect and conductivity) of two intermetallic semiconductors, indium antimonide and indium arsenide. 4.5 Mev electrons were employed in the bombardments. Hall coefficient and resisitivity were measured as functions of temperature and bombardment flux. Various bombardment and annealing experiments are described and methods of analyzing the measurements in order to obtain useful information are discussed.

The experiments on indium antimonide are divided into two groups: bombardments performed at liquid nitrogen temperature, and bombardments performed at dry ice temperature. Bombardments at liquid nitrogen temperature introduce donors and acceptors. It is suggested, in accordance with the model of James and Lark-Horovitz, that the introduced donors and acceptors are interstitials and vacancies, respectively. One bombardment-produced energy level lies at approximately 0.03 ev above the valence band. Other levels lie rather far away from either of the band edges — toward the center of the forbidden gap. These levels were not precisely located on acccunt of experimental difficulties. Mobility measurements performed on samples bombarded at liquid nitrogen temperature indicate that at least some of the defects are multiply ionized.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Annealing occurs in three rather well defined temperature regions: 80 - 85°, 120 - 150°, and 250 - 330°K. This suggests three different annealing processes. The changes during annealing demonstrate that the distribution of bombardment-produced energy levels changes as a sample anneals. It is suggested that this behavior results from geometrical rearrangements of the defects and, possibly, recombination of closely spaced vacancies and interstitials.

Bombardments carried out at dry ice temperature show that the defects stable at this temperature can be understood in terms of the following energy level scheme: levels at approximately 0.048 ev and 0.081 ev above the valence band; and a group of levels in the range 0.03 to 0.10 ev below the conduction band. The centers responsible for these levels are generated at the rate of approximately 1.5/cm in each case.

A calculation of the rate at which vacancy-interstitial pairs should be introduced, assuming a threshold displacement energy of 30 ev, yields the value 3.5/cm. This appears to agree better with the results of liquid nitrogen bombardments than with those of dry ice bombardments.

Mobility measurements carried out on samples bombarded at dry ice temperature indicate that the defects are multiply ionized and that the level near the valence band is a donor level and the group of levels near the conduction band are acceptor levels.

Bombardments on indium arsenide were carried out only at liquid nitrogen temperature. The behavior of the samples during the initial stages of bombardment can be explained if one assumes that donors only are introduced. If acceptors are introduced, they are introduced either in smaller number or less highly ionized than the donors. An apparent anomally was observed in the case of p-type samples, in that the Hall coefficient failed, by many orders of magnitude, to achieve the theoretical maximum during bombardment. It is suggested that this behavior is due to spurious conduction either along surfaces or along grain boundaries. This spurious conductivity might also be responsible for double reversals in the Hall coefficient which occur in heavily compensated samples.

Microfilm $2.50; Xerox $8.40. 181 pages.

SMALL ANGLE X-RAY SCATTERING FROM ALUMINUM HYDROXIDE GEL

(L. C. Card No. Mic 59-5631)

Harold David Bale, Ph.D.
University of Missouri, 1959

Supervisor: Paul W. Schmidt

Aluminum hydroxide gels, prepared under a range of conditions, have been studied at various stages of the aging process by small angle x-ray scattering. The scattering from different fresh gels was found to vary considerably with changes in the conditions of preparation. These effects on the scattering were shown to be primarily related to the valence and concentration of foreign ions present during the precipitation. Large angle x-ray diffraction patterns of the gels indicated that the gelatinous precipitate initially formed is amorphous to x-rays and on aging forms crystallites of one of three types of aluminum hydroxide. The changes in the small angle scattering that occurred during the aging process of the gel could be correlated with changes in the crystal structure of the gel.

By peptizing the gel and scattering from the sol it was possible to estimate the importance of interparticle interference to the scattering curve. Scattering from several of the aged gels was related to platelet shaped particles. Possible scattering structures which could be related to the scattering from the fresh amorphous gels were also discussed. Microfilm $2.50; Xerox $5.20. 103 pages.

THE STATIONARY CHARGED PARTICLE IN A STATIC GRAVITATIONAL FIELD

(L. C. Card No. Mic 59-6430)

Robert Woodruff Brehme, Ph.D.
The University of North Carolina, 1959

Supervisor: Bryce S. DeWitt

The electric field needed to maintain a charged particle at rest in a static gravitational field is compared with that needed to hold the particle fixed with respect to an equivalent accelerated frame in flat space-time and is found to be the same, in agreement with the equivalence principle. The result could not have been foreseen on the basis of the equivalence principle because charge is nonlocal in character, the electromagnetic field associated with it extending into all space. While the methods for solving the equation of motion of a charged body in flat space-time are well known, the ponderomotive equations in curved space, as found by DeWitt and the present author, are much more difficult to treat because of the presence of an integral over the past history of the particle. However, in the static case, with the particle stationary, the derivation of the equation of motion from Maxwell's equations is greatly simplified and leads to a form for the equation of motion which expresses a balance between the force of gravity on the particle and the opposite electrostatic force. Microfilm $2.50; Xerox $3.00. 55 pages.

THE NORMAL VIBRATIONS OF CYCLOPENTANE AND PYRROLE

(L. C. Card No. Mic 59-5370)

Basil Curnutte, Jr., Ph.D.
The Ohio State University, 1953

An analysis of the normal vibrations of cyclopentane and pyrrole had been carried out by means of the "Multiple Origin Method"[1] of analysis. In this method of analysis the internal motions of the molecule are described in terms of the internal motions of certain "characteristic" groups of atoms and the motions of these groups relative to each other.

The analysis of cyclopentane was based on what has been called the planar model. The five carbon atoms lie in a plane at the apices of a regular pentagon and the

hydrogen atoms lie in two parallel planes above and below the plane of the carbon ring. The plane of each CH_2 group is perpendicular to the plane of the carbon ring and bisects the C-C-C angle. The angles and distances of interest are C-C 1.54Å, C-H 1.09Å, C-C-C $\angle$ 108^0, H-C-H $\angle$ 109^0 28′. The symmetry of this model is D_{5h}.

The five CH_2 groups of cyclopentane are the "characteristic" groups used in the analysis. The potential energy function was written in terms of three internal motions of the CH_2 groups, the hindered rotations of these groups about their principal axes of inertia, the motions of the centers of mass of the CH_2 groups out of the plane of the five carbon atoms, the changes in the distances between the centers of mass of adjacent CH_2 groups, and the changes in the angles between the lines joining the centers of mass of adjacent CH_2 groups.

The secular determinant for the vibrations of this molecule was derived in terms of symmetry combinations of the above coördinates. This secular determinant was then solved for the frequencies in terms of the force constants. The values of corresponding diagonal force constants obtained by Deeds in his study of the vibrational spectra of the n-paraffins were used to obtain the approximate frequencies of the normal vibrations of cyclopentane. These approximate values were then used in connection with the band shapes, polarization measurements, the product rule, and specific heat measurements to make the assignment of the vibrational frequencies according to D_{5h} selection rules. Values of the diagonal force constants and interaction constants between the same type of coördinates only were then calculated for this vibrational assignment. The resulting force constants were reasonable and compared well with the force constants of the n-paraffins. A final assignment of frequencies was made by calculating all of the normal vibrational frequencies from the analysis of the D_{5h} model, and it was found that frequencies were observed at the proper frequencies for modes which were forbidden under the D_{5h} selection rules, thus indicating that the symmetry is other than D_{5h}. It was not possible to determine the exact symmetry of the molecule.

The model used in the analysis of pyrrole was a planar model of symmetry C_{2v}, the C_2 axis passing along the N-H bond. The angles and distances were taken to be N-H 1.01Å, C-N 1.42Å, C-C 1.44Å, C=C 1.35Å, C-N-C $\angle$ 104^0, N-C=C $\angle$ 110^0, and C=C-C $\angle$ 108^0. The C-H bonds were assumed to bisect the angle of the ring at their associated carbon atom.

The four CH groups and the NH group were chosen as the "characteristic" groups for the analysis of pyrrole, and the kinetic and potential energy were expressed in terms of the internal motions of these groups and their relative motions. The secular determinant for the molecule was derived in terms of symmetry combinations of these coördinates. This secular determinant was then solved for the normal frequencies of vibration by means of diagonal force constants and interaction constants between the same type of coördinates only, and since there was a good assignment of the vibrational frequencies available[2] these equations were solved for the values of the force constants. It was found necessary to solve the framework portion of the secular determinant numerically by means of a variation of parameter treatment. The result of these calculations was gratifying in that it was found possible to fit the observed vibrational frequencies with a largest error of eight per cent in only one frequency, using fewer force constants than observed frequencies.

The results of this analysis show that the "Multiple Origin Method" yields a greater accuracy in the determination of the normal frequencies of vibration with fewer force constants than in the usual methods of analysis.

During the analysis of cyclopentane it was found necessary to derive the irreducible representations of the symmetry group D_{5h}; a tabulation of these representations is given in this dissertation.

Microfilm $2.65; Xerox $9.20. 201 pages.

1. Deeds, W. E. "Vibrational Analysis of Chain Molecules." Ph.D. Dissertation, The Ohio State University, 1951.

2. Lord, R. C., Jr. and Miller, F. A. "The Vibrational Spectra of Pyrrole and Some of Its Deuterium Derivatives," J. Chem. Phys., 10 (1942), pp. 328–41.

Abstract published by special arrangement with The Ohio State University.

THE INTERACTION OF DISLOCATIONS WITH AN APPLIED STRESS IN ANISOTROPIC CRYSTALS

(L. C. Card No. Mic 59-4505)

Gloria Winkel de Wit, Ph.D.
University of Illinois, 1959

The differential equation of equilibrium is derived for a dislocation pinned at two points in the same glide plane in an elastically anisotropic crystal with an applied stress. It is assumed that the dependence of the dislocation energy on the geometry of the dislocation line is accounted for by using an energy per unit length, E, which for fixed Burgers vector is a function only of Θ, the angle between the Burgers vector and the dislocation segment. A parametric solution of the differential equation is found in terms of E and its derivatives.

When the orientation dependence of E is approximated by that of the elastic energy per unit length of a long straight dislocation, numerical work done for some real face centered cubic and body centered cubic crystals indicates that the first few terms in a Fourier expansion give a good fit to E. Using this expansion, the solution of the differential equation is plotted in such a way that only one curve is needed to obtain the equilibrium shape of the dislocation for all values of the stress. Appreciable deviation from a circle is found.

The above information about dislocation shape versus applied stress, together with some simple assumptions concerning dislocation density enables one to calculate the "average" strain produced in a crystal under applied stress when dislocations are present as compared to a crystal with no dislocations. Such a change in strain would cause an apparent change in measured elastic moduli. The calculation is carried out for face centered cubic crystals and a numerical estimate of the result is made.

Microfilm $2.50; Xerox $6.00. 125 pages.

INVESTIGATIONS OF THE THIRD LAW OF THERMODYNAMICS

(L. C. Card No. Mic 59-5971)

Solomon J. Glass, Ph.D.
Case Institute of Technology, 1959

An investigation of the Third Law is of interest because it is not sufficient to "satisfy the Third Law" by going to low enough temperatures so that the system will be in its ground state; this involves non-thermodynamic behavior. In this paper we investigate what conditions must be imposed on a macroscopic system so that the system will obey the Third Law. We also consider an apparent violation of the Third Law, the processes of vaporization and sublimation.

We first show that if one assumes for a system that the heat capacity vanishes as the temperature approaches zero, then if that system also obeys the Grüneisen equation of state, it will obey the Third Law.

We then ask what conditions should be imposed on the density of states so that the system will obey the Third Law at temperatures greater than that equivalent to the spacing of the lowest two energy states divided by Boltzmann's constant. We discuss two methods of obtaining the density of states from the thermodynamic functions of the system. It is found that if the density of states contains a factor which depends on an external parameter of the system, but not on the energy, the system will violate the Third Law. Also, if the density of states depends on the energy through a power law, the system violates the Third Law. Several systems are analyzed and their densities of state examined.

We then show that in the processes of vaporization and sublimation the presence of the condensed phase compels the vapor to behave as a classical ideal gas. At very low temperatures, the vapor condenses before ever displaying any quantum degenerate effects. The vapor does not exist at absolute zero. The non-zero latent heats at absolute zero obtained in such experiments are due to extrapolations from a temperature at which the vapor still exists.

Microfilm $2.50; Xerox $4.60. 90 pages.

OPTICAL PROPERTIES OF LITHIUM FLUORIDE IN THE INFRARED

(L. C. Card No. Mic 59-4621)

Milton Gottlieb, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. P. H. Miller, Jr.

The investigation was concerned with the interaction of light with the lattice vibrations of lithium fluoride as studied in the range from 2 to 60 μ. This interaction is due principally to the fundamental optical mode of vibration, in which the lattice of alkali ions moves 180° out of phase with the lattice of halide ions. The conventional absorption measurements in this region must be performed on thin films of the crystal, which involves uncertainties of the crystallinity of the material. These uncertainties were avoided by performing reflection measurements on bulk crystals. A Perkin-Elmer 112-prism monochromator was used between 2 and 30 μ and was modified to a grating monochromator for use between 30 and 60 μ.

The reflection band near the reststrahl peak showed a pronounced secondary peak on the short wavelength edge of the band, which is characteristic, to a lesser extent, of the reflection spectra of all the alkali halides. This secondary peak would not be present if the simple model of an ionic lattice were strictly true. In the simple model, the lattice is considered to be equivalent to a collection of charged-mass points bound together by elastic springs.

The secondary structure was exhibited in more physically meaningful form by applying a Kramers-Kronig dispersion relation to the Fresnel reflection formula. An analysis was performed on the IBM-704 computer, and the phase of the reflectivity was determined at some 400 points in the 2- to 60-μ range. For each of these points, using the measured reflectivity and the calculated phase angle, the real and imaginary dielectric constants, the index of refraction, the extinction coefficient, and the absorption constant were determined. The maximum of the imaginary dielectric constant is at 312 cm^{-1}, which corresponds closely to the fundamental optical mode. In addition to the main peak, two secondary peaks appear on the short wavelength side of the maximum. The first peak is at 485 cm^{-1} and probably results from combination modes of vibration. The other peak is at 650 cm^{-1} and may result either from an overtone of the fundamental transverse optical mode or from a coupling of the radiation field with the fundamental longitudinal optical mode.

Reflectivity measurements were performed on approximately 10-μ-thick films of Li^6F and Li^7F deposited on heated substrates of natural lithium fluoride. Since the lattice constants of the pure isotope material and the natural material differ by less than 0.03%, the crystallinity of the films was good. From these measurements it was found that the fundamental optical mode frequency shifted as the square root of the reduced mass, as predicted from the simple model.

In addition to the room-temperature measurements, reflectivity measurements were performed on natural bulk lithium fluoride at 135°, 210°, and 355° K. These measurements, too, were analyzed by applying the Kramers-Kronig dispersion relations, and the optical constants were similarly determined. The reflection band at 485 cm^{-1} in the imaginary dielectric constant becomes sharper at higher temperatures, whereas at 650 cm^{-1} the band remains relatively insensitive to temperature over the range measured. As was expected, the main peak broadens with increasing temperature. The damping constants were evaluated by several methods and were discovered to vary linearly over the temperature range measured.

Microfilm $2.50; Xerox $5.80. 116 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

THE ELECTRONIC EMISSION SPECTRUM OF LEAD TELLURIDE

(L. C. Card No. Mic 59-6305)

Richard Edward Grove, Ph.D.
Syracuse University, 1959

Supervisor: N. Ginsburg

A high-temperature, radio-frequency external electrode discharge technique has been devised which has successfully produced for the first time the molecular emission spectrum of PbTe. Previous efforts[1] have resulted in the excitation of certain other Group IV -Group VI diatomic molecules in emission but these techniques have not proved successful with PbTe.

The present technique employs a resistively heated oven which contains the fused quartz discharge tube and metal loop electrodes, external to the discharge tube, to which the radio-frequency excitation is applied. The oven ends are specially constructed to provide entrance into the oven of the radio-frequency leads in such a way that these leads are not shunted by the hot conducting walls of the oven. The oven ends also provide exit slits for the radiation and heater grids to compensate for the thermal end losses of the oven and thus prevent sublimation of the sample at cooled windows of the discharge tube.

The radio-frequency oscillator operates at about 20 megacycles per second with a plate dissipation of about 450 watts for a plate supply of about 1.5 kilovolts. Oven temperatures up to 1000° C have been employed.

The molecular emission spectrum of PbTe has well developed A → X and B → X systems with a less well developed D → X system partly obscured by strong Pb atomic lines. The B → X assignment of Walker, Straley and Smith[2] is, in general, confirmed but the A → X system as reported by these investigators is not found in the present investigation in either emission or absorption. The A → X electronic-vibrational system found in this investigation has been analyzed and has yielded the assignment of new values for the constants of the first excited state of PbTe.

Revised values for the molecular constants of the ground state and the second excited state are also obtained.

The present work yielded:

For the ground state, X:

$$\omega_e = 211.96$$
$$\omega_e x_e = 0.439$$

For the first excited state, A:

$$T_e = 18405.49$$
$$\omega_e = 127.08$$
$$\omega_e x_e = 0.105$$

For the second excited state, B:

$$T_e = 19737.84$$
$$\omega_e = 144.89$$
$$\omega_e x_e = 0.446$$

The dissociation energy of the ground state of PbTe computed in this work by linear extrapolation of the vibrational levels is 3.17 ev.--a value in good agreement with Gaydon's estimate of 3.5 ev.[3]

Microfilm $2.50; Xerox $3.60. 65 pages.

1. E. E. Vago and R. F. Barrow, Proc. Phys. Soc. London, 59,449 (1947).
2. J. W. Walker, J. W. Straley and A. W. Smith, Phys. Rev. 53,140 (1938).
3. A. G. Gaydon, Dissociation Energies and Spectra of Diatomic Molecules (Chapman and Hall, London, 1947).

STRAIN AGING AND YIELD POINT EFFECTS IN SILVER CHLORIDE SINGLE CRYSTALS

(L. C. Card No. Mic 59-6438)

Milton N. Kabler, Ph.D.
The University of North Carolina, 1959

Supervisor: Lawrence Slifkin

The plasticity of AgCl single crystals has been investigated by repeated straining in tension at a constant strain rate. The crystals were cut from bulk material, polished, etched, and thoroughly annealed. Strain aging and yield point effects were observed in many specimens, the yield point being established after two to four hours aging at room temperature. By deforming at temperatures ranging from -30° C to 100° C, a value of 0.40 ev. was obtained for the activation energy of the aging process.

In all crystals, larger magnitudes of strain aging were correlated with higher impurity concentrations as determined by ionic conductivity measurements. Together with the activation energy for aging and elementary considerations of the time necessary for the aging to occur at a given temperature, this fact indicates that the aging is a process of diffusion of polyvalent cation impurities to dislocations. In order for the crystal to flow plastically, the dislocations must be broken away from an "atmosphere" of pinning impurities. An enhancement of the strain aging effect when aging was carried out under load may be explained according to this model, as may a diminution of the effects at higher temperatures.

Long aging at room temperature resulted in a considerable decrease of the yield point effect, even though the strain aging effect continued to increase slightly. Stable dislocation networks were proposed as a possible cause.

A recovery process, i.e. a decrease in the flow stress upon retesting after aging, was observed in high purity AgCl and was interpreted as due to a reverse movement of dislocations when the external load was removed.

The propagation of plastic deformation during testing was observed via stress birefringence patterns in the crystals. Various microscopic slip structures on the surfaces of the deformed crysals were also studied.

Microfilm $2.50; Xerox $3.00. 50 pages.

PRECISION DETERMINATIONS IN THE SPECTRA OF SINGLE ISOTOPE KRYPTON AND MERCURY

(L. C. Card No. Mic 59-6486)

Victor Kaufman, Ph.D.
Purdue University, 1959

Major Professor: Karl W. Meissner

A final decision may be reached in 1960 to define the meter in terms of the visible radiation, 6056 A, emitted by a neutral atom of Kr^{86} resulting from the transition $2\ p_{10} - 5\ d_5$. A source of this radiation, the Engelhard hot-cathode discharge tube has been investigated. The experiments consisted of a precise measurement of forty-one wavelengths and a quantitative determination of one of the phenomena, the Doppler effect, which causes a small wavelength shift. Most of these lines will, in all probability, be adopted as international secondary standards. Thirty-six lines emitted by a similar source containing Kr^{84} were also measured. The comparison standard for all of the above measurements was Kr^{86} 6056 A, the proposed future primary standard of length.

The Hg^{198} electrodeless discharge tube, (the Meggers lamp), which also emits very sharp spectral radiations, was, at one time, considered as a possible source of the future standard of length. Since it is very simple and convenient to operate, its radiations may also become secondary standards. Six visible radiations from this source were measured with respect to Kr^{86} 6056 A and Hg^{198} 5460 A. The agreement with previous determinations by other investigators is, with few exceptions, within the $\pm$ 0.0002 A claimed.

Interferograms were made at path differences up to 65 cm for a qualitative investigation of the sharpness of the lines of these spectra.

The use of an atomic beam lamp for the production of the primary standard of length is discussed.

Microfilm $2.50; Xerox $5.20. 102 pages.

GEOMETRIC DEPENDENCE OF MAGNETIC ANISOTROPY IN THIN IRON FILMS

(L. C. Card No. Mic 59-5969)

Thomas G. Knorr, Ph.D.
Case Institute of Technology, 1959

Thin iron films produced by vacuum deposition are observed to display a magnetic anisotropy dependent on the geometric location of the evaporating filament. A fiber axis structure is induced during the evaporation. If the direction of incidence of the metallic flux varies from a normal to the substrate this fiber axis tilts in a similar direction. As soon as the fiber axis is no longer normal to the plane of the film, magnetic anisotropy is produced. The variation of the tilt of the fiber axis correlates with and can be shown to account for the geometric dependence of the observed anisotropy. Calculations of the magnetic anisotropy expected in a film with a fiber axis structure and an anisotropic tensile stress in the plane of the film agree with the experimental observations for those films which show only rotational switching. Anisotropies of 3×10^4 ergs/cm^3 have been observed in iron films about 350 A thick prepared without the use of applied magnetic fields either during deposition or during a subsequent thermal anneal. Microfilm $2.50; Xerox $3.80. 68 pages.

VIBRATIONAL SPECTRA OF CFCl:CHBr, C_2H_2FBr, CF_2Br-$CHBr_2$

(L. C. Card No. Mic 59-5493)

Kappagantula Lakshmi, Ph.D.
The University of Oklahoma, 1959

Major Professor: J. Rud Nielsen

The infrared spectra of the compound CFCl:CHBr in the gaseous and liquid states have been obtained at room temperature in the region 2 to 40 μ with a Perkin-Elmer Model 112 double-pass spectrometer. The Raman spectrum of liquid CFCl:CHBr at room temperature and at -50°C has been photographed with a 3-prism glass spectrograph of linear dispersion 15 A/mm at 4358 A. The large number of strong bands in the spectra indicates the presence of two isomeric species, one of them being more abundant than the other. Two sets of vibrational fundamentals have been assigned on the basis of intensities and combinations as follows:

I - Species a′ : 167,225,352,647,803, 1082,1127,1650,3128 cm^{-1}

Species a″ : 146,493,753 cm^{-1}

II - Species a′ : 167,272,352,546,833, 1060,1250,1640,3107 cm^{-1}

Species a″ : 176,434,759 cm^{-1}.

All wave numbers except those below 300 are for the gaseous state. From the shape of the infrared contours an attempt has been made to identify each set with a definite molecular configuration.

The infrared spectrum of gaseous C_2H_2FBr at room temperature and the Raman spectrum of the liquid at -70°C have been observed. The moments of inertia of the three types of molecules represented by C_2H_2FBr (i.e. cis and trans CHF:CHBr and CH_2:CFBr) have been calculated. From the shapes of the infrared contours for the three types, and from other spectral characteristics the principal component responsible for most of the strong bands is identified as CH_2:CFBr. The fundamentals assigned to it are

Species a′ : 363,476,614,946, 1164,1367,1640,3056,3109 cm^{-1}

Species a″ : 416,729,839 cm^{-1}

A few fairly strong bands are ascribed to the other isomeric species present as impurities.

The infrared spectra of CF_2 Br-$CHBr_2$ in the gaseous and liquid states at room temperature, in the solid state, and in different solvents, have been obtained. The Raman spectrum of the liquid at room temperature has been

photographed and polarization measurements have been made. The large number of strong bands indicates the presence of rotational isomers. The wave numbers of the vibrational fundamentals assigned to the two isomers are

I Species a′ : 157,204,333,524,594,648,780,947, 1112,1253,3028

Species a″ : 65,113,284,365,708,1009,1193

II 65,113,169,194,284,333,365,564,574,648, 708,780,947,1028,1140,1193,1253,3001.

From the intensities of the bands at 3001 and 3028 cm^{-1} at different temperatures the value of ΔH has been obtained as 500 ± 150 and 200 ± 100 cal/mole for the gas and liquid, respectively. Although the data are not quite conclusive, the trans form appears to be the more stable and abundant.

Microfilm $2.50; Xerox $5.80. 119 pages.

THE BOND MOMENTS AND BOND DERIVATIVES OF DIFLUOROMETHANE FROM INFRARED ABSORPTION INTENSITIES

(L. C. Card No. Mic 59-5563)

Andrew Joseph Lavin, Ph.D.
The University of North Carolina, 1959

Supervisor: Joseph W. Straley

The integrated absorption coefficients, or absolute intensities, of the vibration-rotation bands of difluoromethane were determined by means of the Wilson-Wells extrapolation technique. Overlapping bands were resolved with the help of the high resolution study made by Stewart & Nielsen. The assigned values are, in cycles/cm-sec

$$A_1 = 66 \times 10^{10}$$
$$A_2 = 1270 \times 10^{10}$$
$$A_3 = 7.3 \times 10^{10}$$
$$A_4 = 290 \times 10^{10}$$
$$A_6 = 540 \times 10^{10}$$
$$A_7 = 130 \times 10^{10}$$
$$A_8 = 130 \times 10^{10}$$
$$A_9 = 3200 \times 10^{10} .$$

The normal coordinates were found by solution of the generalized eigenvalue and eigenvector problem associated with the vibrational motion.

A set of eight linear equations was derived which relates the polar property parameters to the rates of change of dipole moment with respect to normal coordinates, $\partial \mu_T / \partial Q_i$. Simplifying assumptions reduced the parameters involved to those encountered in the "bond moment" model.

These equations were combined with experimentally determined $\partial \mu_T / \partial Q_i$ to give a set of eight linear equations in four unknowns. Two of the equations were incompatible with the other six due to electrical anharmonicity in these modes. Ambiguities in sign of the $\partial \mu / \partial Q_i$ necessitated a careful elimination of solutions on the basis of mathematical incompatibility and physical reasoning. The solution which was arrived at after these considerations is

$$\mu_H = + .19 \pm .02 \text{ D} \quad \partial \mu / \partial r_H = - .99 \pm .04 \text{ D/A}$$
$$\mu_F = +2.08 \pm .09 \text{ D} \quad \partial \mu / \partial r_F = +4.56 \pm .29 \text{ D/A} .$$

It was concluded that a detailed study of the form and amplitudes of the normal modes might be necessary, in general, before equations, even from the same symmetry class, can be assumed to be compatible.

Microfilm $2.50; Xerox $8.60. 188 pages.

A SPACE-TIME ANALYSIS OF SONOLUMINESCENCE

(L. C. Card No. Mic 59-5644)

Robert Quinn Macleay, Ph.D.
University of Missouri, 1959

Supervisor: Professor L. V. Holroyd

The relative intensity of sonoluminescence as a function of the phase angle of the sonic field from which the photons originate has been obtained experimentally. The distribution over phase angle appears to approximate a Gaussian with a mean of 260° and a variance of 47°. The form of the distribution does not change significantly with a change in the pressure of the sonic field in the range 1.8 atmos. to 2.8 atmos. Also there is little change with sonic frequency from 400 kc to 1200 kc. The intensity of the luminescence is found to be greater in the region of a pressure antinode than from the region around a pressure node.

Since the luminescence occurs in the compression phase of the sonic field, theoretical considerations based upon the theory of Noltingk-Neppiras produces distributions which are in good agreement with those obtained from experiment. Microfilm $2.50; Xerox $5.40. 109 pages.

THE ELECTRICAL AND OPTICAL PROPERTIES OF THE SEMICONDUCTOR TIN SELENIDE

(L. C. Card No. Mic 59-6310)

Dean Lewis Mitchell, Ph.D.
Syracuse University, 1959

Supervisor: Henry Levinstein

The semiconductors PbS, PbSe, and PbTe have attracted wide study because of their value as detectors of infrared radiation. This interest has not been extended to related semiconductors such as GeS, SnS, and SnSe. Tin selenide was selected as a representative of this group so that a thorough study of its properties as a semiconductor could be made. An incidental but necessary preliminary to this study was an investigation into the ways and means of preparing pure single crystals of this material.

Several methods of growing single crystals of SnSe were investigated. One of these, the vapor technique, provided crystals with a high degree of crystal perfection and a very low concentration of excess charge carriers. All of the crystals prepared exhibited "p" type conduction. It was not possible to prepare "n" type crystals or to observe any effects of "n" type conduction.

These crystals all exhibited one set of cleavage planes which allowed preparation of samples as thin as 20 microns. The crystal structure was determined by means of x-ray diffraction and found to be isomorphic with that of SnS. The lattice constants are given by a = 4.40 A^0, b = 11.45 A^0, c = 4.15 A^0. This structure is orthorhombic but it may also be described as a slight distortion of the face-centered-cubic lattice which is characteristic of the other group IV group VI compounds.

No effects of this anisotropy were noted in the electrical conductivity and Hall constant. The anisotropy was evident in the measurements of the index of refraction and the intrinsic optical absorption. Two indices of refraction, $n_1 = 4.6$ and $n_2 = 5.0$, were observed for the two directions of polarization perpendicular to the b crystal axis. The absorption edge for indirect transition was also observed to shift with polarization. The cut-off energies for the two components of the indirect transitions were observed at .90 ev and .86 ev respectively. The cut-off energy for the direct optical transitions was observed at 1.20 ev.

The effective mass for holes was determined from the measured values of the mobility μ_h(100 cm^2/volt-sec) and the relaxation time τ_h(1 x 10^{-14} sec). The value $m_h^* = .2\ m_e$ should be accurate within a factor of two. The very short relaxation time is of interest since it allows the study of the electrical conductivity in the region where $\omega\tau = 1$.

Also of interest is the absence of any conduction effects due to "n" type carriers. The absence of these effects in the high resistivity sample V-1 indicates a low mobility for electrons in the conduction band. This absence of electronic conductivity has also been observed in other low mobility semiconductors such as GaSe and anthracene. It has not been determined whether this is due to trapping of the electrons or perhaps due to the actual absence of a true conduction band.

In general, the properties of SnSe seem to relate more to the valence type crystals such as Si than they do to the ionic salts PbSe and PbTe. The $T^{-3/2}$ dependence of mobility on temperature, the direction of the shift of the optical absorption edge with temperature, and the location of the absorption edge all differ from those observed in the lead salts. The grouping of the atoms within the crystal also indicates that the bonding is of the valence type and is non-ionic in character.

Microfilm $2.50; Xerox $3.80. 69 pages.

THE INFLUENCE OF THE ABSORPTION OF RADIATION IN SHOCK TUBE PHENOMENA

(L. C. Card No. Mic 59-3019)

Jacob Pomerantz, Ph.D.
University of Maryland, 1958

Supervisor: Dr. J. M. Burgers

A theoretical investigation is made of the influence of the absorption of continuum radiation on the gas flow variables behind a strong shock wave advancing into argon at room temperature. A derivation of the emission formula for the total continuum radiation from an ionized gas brings out the need for knowing the amount that the ionization potential is lowered in a plasma. A review of the literature led to the choice of Ecker and Weizel's expression for the ionization potential lowering. Numerical results obtained by combining this expression with the usual shock equations are presented for the equilibrium conditions that are assumed to exist at the plane of maximum luminosity.

The absorption at a point behind the plane of maximum luminosity depends on the energy emitted from every element of the luminous region, modified by the absorption along the paths from the emitting elements to this point. The emergy emitted from an element depends on the as yet unknown conditions at the element. Thus, the absorption at a point depends on the knowledge of the complete structure of the luminous region that we are seeking to determine. A "relaxation" method for finding the rate of absorption per unit mass is presented. In principle, the method is quite general. Here it is used to find the energy absorbed at points in a "shock tube" of finite length and infinite optical cross section, i.e., there is essentially no contribution of radiative energy to a point from points in the same cross section sufficiently far removed. Moreover, the luminous region in this "tube" is assumed to be stratified into plane parallel layers in each of which uniform conditions exist. The absorption term found by this method is introduced into the energy equation. The ionization potential that is present in the energy equation is regarded, of course, as a variable. To obtain an expression for the variation of the degree of ionization with distance, it is necessary to combine the energy equation with the differential forms of the following equations: the equation of state, the Saha equation, the equation for the lowering of the ionization potential, and the conservation equations of mass-flow and momentum. The resulting expression together with similar expressions for the other variables constitute a system of differential equations which were solved (on an IBM 650 computer) both with and without the inclusion in the energy equation of the term for the absorbed energy. Numerical calculations accurate as far as third-order terms showed that the assumptions underlying the "relaxation" method were valid.

Results are presented for shock waves of about Mach number 17 advancing into argon at densities of both 1/76 and 1/10 atmosphere, and for a shock wave of Mach number 16 advancing into 1/2 atmosphere of argon. It is found that for a given Mach number the effect of the absorption of energy is to bring the variables to an essentially constant value in a distance which depends on the density ahead of the shock. The greater the density, the shorter is this distance, and the closer is the magnitude of this constant value to the initial value at the plane of maximum luminosity.

A method is also presented for finding the absorption energy near the center line of a shock tube of finite optical depth. Thus, the influence of the absorption of energy on the flow variables behind the plane of maximum luminosity may be determined for this case, too.

Microfilm $2.50; Xerox $6.80. 144 pages.

THE CONSTRUCTION OF THE DIRAC EQUATION CENTRAL POTENTIAL FROM PHASE SHIFTS AND BOUND STATES

(L. C. Card No. Mic 59-3020)

Francisco Prats, Ph.D.
University of Maryland, 1958

Supervisor: Dr. John S. Toll

The problem of the connection between phase shifts, bound state energies and the potential is studied for a Dirac particle in a spherically symmetric potential. An explicit method is developed for the construction of the potential from the scattering and bound state data for a single angular momentum and parity. The technique used in this relativistic problem is an extension, appropriatedly generalized to matrices of the methods used by R. Jost and W. Kohn for the non-relativistic case.

The spherical symmetry of the interaction allows separation of the Dirac wave function into radial and angular dependent parts. The radial dependent part consists of two components satisfying a system of differential equations. The physically admissible solutions, or eigenvectors are expressed as combinations of the solutions which are asymptotic to incoming and outgoing waves. A unified treatment of the scattering and bound states can then be given in terms of these solutions, and, for potentials with $\int_0^\infty r^n|V(r)|dr$ finite for n = 0, 1, and 2, we then utilize certain analytic properties (proved by D. S. Carter) of the solutions as functions of the linear momentum. The expansions of arbitrary vectors in terms of the eigenvectors are most conveniently expressed when the spectral function is introduced; this spectral function is constructed from the phase shifts for both positive and negative energies, the bound state energies and the norm of the bound states wave functions. In terms of this spectral function, the orthonormality and closure properties of the eigenvectors are proved by use of the analytic properties of the eigenvectors.

After it is shown that the radial wave equation eigenvectors form a complete system, a generalization of the Gel'fand and Levitan method is developed for the determination of the potential from the spectral function. The first step is to relate two systems of eigenvectors associated with different potentials. From the operator that appears in the relation between the eigenfunctions a modified kernel is defined which has two important properties with respect to the problem of the construction of the potentials. First, it satisfies an integral equation of the Fredholm type (analogous to the Gel'fand and Levitan integral equation) which can be constructed from the spectral function and eigenfunctions corresponding to a "Comparison potential" and the spectral function associated with the "unknown potential." Second, the potential difference is determined by the differentiation of a certain combination of the elements of the modified kernel.

The proof of these properties thus leads to the following method for the construction of the potential from the phase shifts and bound state data:

(1) the spectral function is determined from the data

(2) with the spectral function for the unknown potential and the spectral function and eigenfunction of a convenient comparison potential, the integral equation for the modified kernel is constructed

(3) from the solution of this integral equation, the difference between the unknown and the comparison potentials is determined.

Microfilm $2.50; Xerox $5.80. 118 pages.

THE ABSORPTION OF LIGHT BY LIGHT AND ITS APPLICATION TO THE CONVERGENCE OF PERTURBATION THEORY

(L. C. Card No. Mic 59-3023)

Howard Robert Reiss, Ph.D.
University of Maryland, 1959

Supervisor: Dr. John S. Toll

The mutual absorption of two non-parallel classical photon fields through the production of electron pairs is calculated by Dirac electron theory. One of the photon fields is treated accurately in the sense that wave functions are employed which are solutions of the Dirac equation containing the potential of this photon field in the Hamiltonian. The second photon field is introduced as a first order perturbation to the system containing the first field. It is shown that the calculation of the absorption process properly reduces to the previous calculations of the limit of small field strength and of the limit of small energy of the photons in the first field. The general results of the theory in which one of the fields is treated accurately are examined to determine the validity of a perturbation expansion in terms of this field. It is shown that the radius of convergence of this perturbation series is non-zero except for a discrete set of particular combinations of the photon energies of the two fields. The physical process is described in terms of a total transition probability, and the method employed is to show that this total transition probability is given by a series of analytic functions which are uniformly convergent within a certain region. This region of uniform convergence is not determined explicitly, but a lower bound is found for its radius. These results are of particular importance because of their significance for the critical question of the convergence of perturbation theory in quantum electrodynamics. The present work is a rigorous treatment of the case when the fields are not second-quantized, and shows that perturbation series will converge at this stage in the development of the theory.

Microfilm $2.50; Xerox $4.60. 86 pages.

THE PRESSURE DERIVATIVES OF THE ELASTIC CONSTANTS OF ALUMINUM AND MAGNESIUM TO 6,500 BARS

(L. C. Card No. Mic 59-5967)

Richard E. Schmunk, Ph.D.
Case Institute of Technology, 1959

The pressure derivative of the elastic stiffness constants of aluminum and magnesium have been measured

over a pressure range from 0 to 6500 bars, using a modified ultrasonic pulse echo method. The values found for the pressure derivative of the elastic stiffnesses of aluminum and magnesium are:

	dC/dP	dC'/dP	dB_S/dP		
Al	2.31	1.62	5.19		
	dC_{11}/dP	dC_{33}/dP	dC/dP	dC'/dP	dC_H/dP
Mg	6.11	7.22	1.58	1.36	13.7

The notation, $C = C_{44}$, $C' = (C_{11}-C_{12})/2$, $B_S = (C_{11}+2C_{12})/3$, and $C_H = C_{11} + C_{12} + 2C_{33} - 4C_{13}$ has been used. The pressure data for aluminum has been interpreted in terms of Leigh's theory for the elastic stiffnesses themselves, and the magnesium data in terms of the theory of Reitz and Smith. Variation of the effective charge density at the boundary of the atomic polyhedron under volume strain causes the electrostatic contribution to the shear stiffnesses to vary approximately as r^{-8} instead of r^{-4}, for both metals. Electron transfer from states overlapping one type of Brillouin zone face to states overlapping another type of face under volume strain contributes appreciably to the variation of the Fermi shear stiffness with pressure. Microfilm $2.50; Xerox $3.00. 39 pages.

LATTICE VIBRATIONS IN BODY-CENTERED-CUBIC LATTICES, WITH AN APPLICATION TO VANADIUM.

(L. C. Card No. Mic 59-5582)

Deoki Nandan Singh, Ph.D.
The University of North Carolina, 1959

Supervisor: Wayne A. Bowers

Experiments on the incoherent inelastic scattering of slow neutrons by solids are capable of giving the frequency spectrum of lattice vibrations directly, in contrast to other experimental methods which give it only indirectly. Recently such experiments have been performed for metallic vanadium. In this work we investigate the frequency spectrum of vanadium, by the Born-von Karman method, for several different models.

As we do not know the atomic force constants of the Born model, we have made use of the bulk and the shear moduli of the polycrystalline material at room temperature, and the value of the effective Debye temperature Θ_D from the specific heat measurement at very low temperatures ($1 \sim 5^\circ K$), for evaluating the three moduli of elasticity of vanadium. This allows us to determine three atomic force constants at the most, and we have suggested three three-constant models. Model A considers the first neighbor interaction non-central, the second one central, and neglects higher neighbor interactions; Model B considers the first neighbor interaction non-central, the second one central, the third one central with a particular restriction, and neglects higher neighbor interactions; and the last Model C considers first and second neighbor interactions central with the inclusion of the electronic gas participation, and neglects higher neighbor interactions.

For Models A and B, the histograms for the frequency distribution have been calculated making use of the IBM 650 computer. Also for Model A, use has been made of a critical point investigation in drawing a continuous curve from the histogram. To make the usual comparison with the experimentally measured specific heat data, we have calculated the effective Debye temperature Θ_D using the frequency spectrum of Model A, and also that from the specific heat after subtracting the electronic contribution and the thermodynamic difference term. For Model C, we have calculated the atomic force constants and the modifying constant taking care of the electron gas, but have not made detailed calculations of the spectrum.

The general agreement in the shape of the frequency spectrum between the experimental curve and the histograms for the models A and B is encouraging, although all the theoretical curves exhibit three peaks, whereas the experimental curve shows only two. The extra peak appears on the low-frequency side of the spectrum in all the theoretical curves. The maximum cutoff frequency cannot be compared very well, as it rather tails out for the experimental curve, but the agreement is best with Model A. The third peak height is always greater than the second one, in qualitative agreement with the experiment. There is more piling up of the roots on the lower side of the frequency on the theoretical histograms than on the experimental curve. The positions of the second and the third peaks on the frequency scale are the same in the theoretical curve of Model A and the experimental curves. There is rather a large difference between the calculated and the experimental effective Debye temperature Θ_D, the calculated one being always low. The calculated one first decreases, then increases, becoming constant to a certain value at high temperatures, whereas the experimental one always increases with temperature.

Under the assumptions, the agreement with the experiment is quite reasonable. Any further improvement in agreement would require a knowledge of the experimentally determined values of the elastic constants as a function of temperature. We should also take into consideration more completely the effects of the electron gas. To compare the calculated specific heat with the experimental data, we must also have a quantitative knowledge of the anharmonic contribution at different temperatures.

Microfilm $2.50; Xerox $4.40. 84 pages.

X-RAY K ABSORPTION SPECTRA OF SOLID ARGON AND KRYPTON

(L. C. Card No. Mic 59-6638)

Jack Arbuthnott Soules, Ph.D.
The Ohio State University, 1954

The x-ray spectra of solids have been studied since 1920 with the hope of gaining an understanding of the role of the atomic electrons in determining the properties of the solid. The x-ray emission spectra of many metals have been obtained and used to demonstrate the existence of electron bands of the type predicted by Bloch and others. Similarly, the absorption spectra of many metals have been observed in an effort to gain understanding of the density of unfilled states available to the electrons. A few

experiments of this type have also been made on insulators, such as K Cl.[1] A recent paper by Cauchois and Mott[2] suggests that the x-ray absorption spectrum of an insulator should consist of a series of discrete lines lying just below an absorption band corresponding to transitions of an inner atomic electron into the empty conduction band of the solid. The discrete lines are caused by transitions into unfilled exciton levels formed in the neighborhood of the ionized atom. Some evidence of this effect has been observed in the spectrum of K Cl and other salts.

The condensed noble gases are particularly well suited to investigations of the electron bands of insulators because the atomic x-ray spectra are well understood. The lattice spacings of the crystallized noble gases are large; this reduces the overlap of the electron wave functions and permits a clearer interpretation of experimental results than in the case with solids of other types.

A cryostat was built suitable for liquid helium temperatures and so constructed that the gas to be studied could be sprayed against a cold window and frozen in the form of a thin film. The cryostat was equipped with suitable thin beryllium windows to permit the x-ray beam to pass through the absorber and the liquid helium refrigerant. Argon was chosen as the element for study since the x-ray K absorption edge structure of the gas is well known[3] and the wavelength region (3.9 Å) is amenable to experiment. The x-ray absorption spectra of both the gas and the solid were studied with the use of a two crystal vacuum spectrometer with calcite crystals. Preliminary experiments with quartz crystals produced intensities too low for adequate precision of measurement. A proportional counter detector and a gold target x-ray tube operated at 8 kv., and 40 ma. were used. Data were taken over a wide energy region extending to 180 volts on the high energy side of the absorption edge. The earlier results on argon gas were confirmed, and in addition a series of strong absorption bands were observed in solid argon. The solid argon absorption consists of 3 well defined maxima, including a very strong band at the absorption edge. The absorption edge is very sharp, rising to a peak absorption of the order of 2600 cm.^{2}/g., and falling less steeply on the high energy side of the principal band. The absorption edge occurs at -1.6 electron volts from the ionization potential of argon gas. A comparison of the observed spectrum with the series of absorption minima predicted by Kronig theory[4] showed a qualitative but not detailed agreement.

Table I

Principal Absorption Edge Structure of Argon and Krypton

Absorption Feature	Position in Argon Spectrum	Position in Krypton Spectrum
A	- 1.6 ev	+ 5.4 ev
α	+ 4.7	+ 9.8
B	+ 7.2	+15.8
β	+ 8.4	
C	+10.9	
γ	+17.2	
D	+20.9	
δ	+28.4	

Following the experiments on solid argon, a similar experiment was performed using krypton, whose K absorption edge is at 0.87 Å. No fine structure could be resolved in the krypton gas in agreement with earlier results,[5] but two absorption bands were observed in solid krypton. The sharp initial edge occurs at +3.5 electron volts with respect to the ionization potential of krypton gas. Table I lists the maxima and minima observed in the absorption spectra of solid argon and krypton, using the (A, α, ...) notation suggested by Veldkamp.[6] Energies in each case are measured from the ionization potential of the gas atom. Microfilm $3.05; Xerox $10.40. 234 pages.

1. Trischka, J. W. "Structure in the X-Ray K Absorption Edges of Solid Potassium Chloride," Phys. Rev., 67 (1945), pp. 318–20.

2. Cauchois, Y., and Mott, N. F. "The Interpretation of X-Ray Absorption Spectra of Solids," Phil. Mag., 40 (1949), pp. 1260–69.

3. Parratt, Lyman G. "X-Ray Resonance Absorption Lines in the Argon K Spectrum," Phys. Rev., 56 (1939), pp. 295–7.

4. Kronig, R. de L. "Zur Theorie der Feinstruktur in den Rontgenabsorptionsspektren. II," Zeit. f. Phys., 75 (1932), pp. 191–210.

5. Shaw, C. H. "The K Absorption Edges of Br (35) and Kr (36)," Phys. Rev., 57 (1940), pp. 877–81.

6. Veldkamp, J. "Einfluss des Gittertypus auf die Feinstruktur der Rontgenabsorptionskanten," Zeit. f. Phys., 77 (1932), pp. 250–6.

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THE ATOMIC DISTRIBUTION IN LIQUID SULPHUR

(L. C. Card No. Mic 59-5655)

Clifford Ware Tompson, Ph.D.
University of Missouri, 1959

Adviser: Professor N. S. Gingrich

A study has been made of the X-ray diffraction patterns obtained from samples of liquid sulphur at temperatures between 80 °C and 300° C and from amorphous sulphur at 4° C and from powdered orthorhombic sulphur at room temperature. The X-ray beam incident upon the sample had been reflected from a crystal which selected nearly monochromatic Kα radiation of molybdenum or of silver. The use of a scintillation counter provided a sensitive detector and a means to electronically discriminate against second-order half-wavelength radiation reflected by the crystal.

The diffraction patterns that have been obtained resolve the discrepancies which exist in the literature relating to the location of the main peak in the liquid patterns as a function of the temperature, and to the possible existence of an extra peak near the main one. In the present work two diffraction peaks are clearly visible and their angular position is seen to be independent of the sample temperature. Changes that occur with temperature in the relative intensities of these two peaks can explain the apparent shift in the location of the main peak as has been earlier reported by others.

After appropriately correcting the experimentally

determined intensity data for the effects of background scattering, polarization, absorption and incoherent scattering, the corrected intensity was normalized to absolute units by using the most reliable fitting techniques available. From these normalized intensity data the atomic radial distribution curves were calculated. These calculations were performed with the aid of an IBM 650 digital computer. The speed of this computer made feasible a series of calculations designed to investigate the sensitivity of the analysis to arbitrary adjustments in the calculation. For example a study was made of the effect on the distribution function of (1) terminating the calculation at arbitrary points and (2) modifying the data by an arbitrary exponential factor similar to procedure sometimes used in crystal analysis.

Atomic distribution curves obtained for all sulphur samples showed a discrete concentration of about 2 nearest neighbors at 2.07A. It was shown empirically that errors in the area of this peak could be compensated for by including the areas of the spurious ripple peaks that arise from experimental limitations such as the impossibility of extending measurements to infinite values of $(\sin\theta)/\lambda$.

This discrete peak and other concentration peaks which occurred at larger radii were correlated to atomic positions in a puckered ring of 8 sulphur atoms, the molecular structure of sulphur below 165°C. Above this temperature long chain molecules begin to form, and this was reflected in the distribution function by a severe smearing of the concentration peaks at the larger radii but the maintaining of a discrete concentration of two atoms at 2.07A. This discrete peak seemed to be slightly lowered and broadened, however, indicating a thermal effect on the atomic motions within the molecule.

Microfilm $2.50; Xerox $6.40. 135 pages.

PHYSICS, ELECTRONICS AND ELECTRICITY

THE NATURE OF SPACE CHARGE AND CURRENT FLOW IN DIELECTRIC LAYERS BETWEEN CYLINDRICAL ELECTRODES

(L. C. Card No. Mic 59-5974)

Robert Dane Barnard, Ph.D.
Case Institute of Technology, 1959

Steady state flow of single (majority) charge carriers in insulator media between cylindrical electrodes is analyzed. Appropriate boundary conditions for carrier density in metal and semiconductor electrodes are applied, and accurate general solutions of the nonlinear conduction-diffusion equation are developed. Because of transcendental complexity, and since current values in insulators are small, the problem is treated by perturbation theory as a zero-current electrostatic state with small current perturbations. Practical expressions are developed to zero and first order, valid for large and small radii of curvature, for the inner potential, electric intensity, carrier density, charge transfer, and radial electric field stress within the dielectric. Electron atmosphere distributions and adhesion stress phenomena are investigated, namely, the equilibrium charge transferred across cylindrical junctions (phase boundaries), electrical stresses at electrode-dielectric interfaces, and criteria for zero electric stresses at junctions.

Rectification resulting from space charge accumulation in insulators is investigated; the applied potential - resulting current relationship is derived, and dependence of rectification characteristics on curvature and on electrode work functions is analyzed quantitatively.

Finally, expressions exhibiting dependence on curvature and on the chemical nature of electrodes are derived for barrier layer resistance and capacitance.

Microfilm $2.50; Xerox $4.00. 72 pages.

OPTICAL STUDIES OF IMPURITIES IN GERMANIUM

(L. C. Card No. Mic 59-6307)

Leo Francis Johnson, Ph.D.
Syracuse University, 1959

Supervisor: Henry Levinstein

The fundamental parameters of gold in germanium have been investigated between 60 - 300°K by absorption, photoconductivity, and recombination radiation studies.

Photoconductivity measurements reveal the following capture cross sections for electrons and holes at 80°K (subscript refers to carrier being captured; superscript to charge state of gold center): $\sigma_h^- \simeq 1 \times 10^{-13}$ cm², $\sigma_e^0 \simeq 6 \times 10^{-14}$ cm², $\sigma_e^- \sim 10^{-17}$ cm². Lifetime studies on n-type samples show the existence of a 0.018 ev Coulomb barrier at singly-charged gold sites and an indication that a thermal (phonon) mechanism is involved in the electron capture process. The lifetime also manifests itself in the noise spectrum.

The photoconductive absorption cross section at 80°K of p-type gold-doped germanium (0.15 ev level) is found to be 2×10^{-16} cm² at 1.8 microns. It is suggested that differences between the absorption and photoconductive spectra are due to departure from spherical symmetry of valence band contours away from $\underline{k} = 0$.

Recombination radiation is observed which cannot be identified with any intentionally introduced impurity (Au, Zn, or Sb). Emission at 0.5 ev is correlated with the presence of edge dislocations, and observations suggest a model in which a dislocation produces a deformation of the energy bands, resulting in intrinsic recombination across a reduced band gap. The origin of emission between 4 and 20 microns is unknown. Indications are that it arises from recombination at point imperfections (vacancies and/or interstitial germanium atoms).

Microfilm $2.50; Xerox $7.00. 150 pages.

TRANSIENT BEHAVIOR OF SEMICONDUCTOR JUNCTION DIODES — THEORY AND APPLICATIONS.

(L. C. Card No. Mic 59-5966)

Wen-Hsiung Ko, Ph.D.
Case Institute of Technology, 1959

The forward and reverse transient behavior of junction diodes are analyzed and the theoretical results verified experimentally. The forward transient behavior is resolved into junction voltage and diode resistance transient components. The theory yields satisfactory explanation of all the observed phenomena. The diode reverse transient behavior after a forward current pulse is also analyzed approximately. Equations are obtained to determine quantitatively the reverse recovery current and voltage as functions of carrier lifetime and circuit parameters. The relation between the charge stored by forward current and the charge recovered by reverse current is then derived. These equations are confirmed with an accuracy of five percent or better by experimental data from germanium and silicon alloyed diodes. The temperature effect on the diode transient behavior is demonstrated to be dependent only on the change of carrier lifetime with temperature.

Based on the understanding obtained, several applications are investigated briefly. These are:

(1) Measurements of carrier lifetime, surface recombination velocity, injection ratio, base resistance, and junction temperature.

(2) Diode Pulse Repeaters and Diode Amplifiers.

(3) Diode Amplitude Modulator, Sampler, Pulse Duration Modulator, and Pulse Position Modulator.

A number of other possible applications are also suggested in the appendix. Microfilm $2.50; Xerox $6.20. 128 pages.

NEGATIVE HYDROGEN ION PRODUCTION BY THE BOMBARDMENT OF A TUNGSTEN SURFACE BY POSITIVE IONS IN THE ONE KEV RANGE

(L. C. Card No. Mic 59-6309)

Leonard Phillip Levine, Ph.D.
Syracuse University, 1959

Supervisor: H. W. Berry

The formation of negative ions by positive ion bombardment of a tungsten surface is studied in the range of positive ion energies from 1000 to 2000 ev. The apparatus used is a double mass spectrograph, allowing analysis of both the incoming positive and outgoing negative ion beams. Two peaks are studied; a low energy peak of negative hydrogen ions created under bombardment of a dirty surface by any positive ion, and a high energy peak of negative hydrogen ions created under bombardment of a surface by either molecular or atomic positive hydrogen ions and by no other.

The height of the low energy peak as a function of the temperature of the surface is found to be proportional to the amount of hydrogen on the surface. The curve has a sharp peak which is 3 volts wide at its half maximum, and a tail on the high self energy side 25 volts long.

The high energy peak ranges from a self energy of zero to a value corresponding to a collision of a proton in the incoming ion beam with one of the surface's atoms. This curve is flat over its whole energy range, dropping to zero at the low self energy end in a manner independent of incident ion energy. On a clean surface the shape of this curve is independent of target temperature.

The shape of the high energy curve is compared with curves predicted by a random walk-collision theory, and a theory based on the loss and gain due to scattering of velocity groups. The shape of the low energy curve is compared with a thermal desorption of the ions from the surface coupled with a mechanism for the neutralization of the ions as they leave the surface.

Microfilm $2.50; Xerox $5.60. 112 pages.

PHYSICS, NUCLEAR

POLARIZATION IN PROTON-PROTON SCATTERING NEAR 3.5 MEV

(L. C. Card No. Mic 59-6972)

Igor Alexeff, Ph.D.
The University of Wisconsin, 1959

Supervisor: Assistant Professor Willy Haeberli

One way of obtaining information on the forces between two protons is by investigating the polarization produced in protons scattered from protons. According to Hull and Shapiro,[1] and to MacGregor,[2] the present experimental information suffices only to place limits of ± 4% on the polarization that might occur at energies near 3.5 Mev.

In this experiment, polarization was measured to better than ± 0.3% by performing a double scattering experiment. Protons were first scattered from hydrogen. The scattered protons were then scattered from helium, and the asymmetry in the left-right scattering was measured by means of two proportional counter telescopes. Coincidence techniques reduced background effects to less than 0.25%. The gas density in the first and second scatterers was locally increased by cooling with liquid air. A general analysis of the corrections due to the finite geometry in a double scattering experiment with rectangular slits was performed.

The polarization produced in proton-proton scattering was investigated at 30°, 45°, and 53° c.m. At 30°, the polarization is zero. At 45°, the polarization may be zero, but is likely to be positive. At 53°, the polarization appears to be positive, being + (0.48 ± 0.22%). With the rms error quoted, the probability of having zero or negative polarization is one part in 70.

The polarization agrees in sign with that known to be present at energies above 46 Mev.[3] The results of the experiment will be useful in resolving present ambiguities in the values of proton-proton scattering phase shifts. The experiment also shows that detecting polarization of a few tenths of a percent is experimentally possible.

Microfilm $2.50; Xerox $5.00. 99 pages.

1. M. H. Hull and J. Shapiro, Phys. Rev. 109, 846 (1958).
2. Malcolm H. MacGregor, "Phase Shift Analysis of Proton-Proton Scattering Experiments below 40 Mev," U.C.R.L. 5348, Feb. 17, 1959.
3. Palmieri, Cormack, Ramsey, and Wilson, Annals of Physics 5, 299 (1956).

INVESTIGATION OF A PREDICTED MAXIMUM IN THE POTENTIAL ENERGY PLOT OF THE $^3\Sigma_u^+$ STATE OF THE HELIUM MOLECULE

(L. C. Card No. Mic 59-6701)

Samuel John Brient, Jr., Ph.D.
The University of Texas, 1959

Supervisor: F. A. Matsen

This dissertation is an investigation of a maximum in the interaction energy between a normal and a metastable helium atom as calculated by Buckingham and Dalgarno.[1] In their paper, they remark that their result demonstrates that maxima can arise simply from the ordinary overlapping of the charge distributions of separate atoms. Such maxima are known in other diatomic molecules. However other explanations are given for their existence.

The significance of this result is further demonstrated by the favourable agreement with experimental determinations of the diffusion and total elastic scattering cross-sections, when compared with a theoretical calculation[2] using this interaction energy.

The first of two methods of investigation is to use an analytical function, the Hulburt and Hirschfelder function,[3] to predict the plot from spectroscopic data. All the parameters in the Hulburt and Hirschfelder function may be computed, except the dissociation energy. The dissociation energy was evaluated using a linear Birge-Sponer extrapolation.[4] In light of the rules given by Gaydon for estimating the dissociation energy from such an extrapolation it was concluded that there is not a maximum in the potential energy plot.

The second method of investigation is a total molecular calculation at an internuclear distance of four atomic units. This is a variation calculation using a valence bond type function and configuration interaction. The first three configurations of lowest energy were used. They were $(1s)^2\ ^1S + (1s,2s)^3S$, $(1s)^2\ ^1S + (1s,2p)^3P$, and $(1s,2s)^3S + (1s,2s)^3S$. The results of this calculation again lead to the conclusion that there is no maximum in the plot of interaction energy for the $^3\Sigma_u^+$ molecular state.

Microfilm $2.50; Xerox $4.80. 93 pages.

1. R. A. Buckingham and A. Dalgarno, Proc. Roy. Soc. (London) A213, 327 (1952).
2. R. A. Buckingham and A. Dalgarno, Proc. Roy. Soc. (London) A213, 506 (1952).
3. H. M. Hulburt and J. O. Hirschfelder, J. Chem. Phys. 9, 61 (1941).
4. A. G. Gaydon, Phy. Soc. of London 58, 525 (1946).

ON THE THEORY OF PHOTODISINTEGRATION OF Li^6

(L. C. Card No. Mic 59-5975)

Fred Buskirk, Ph.D.
Case Institute of Technology, 1958

The experimental cross section for photodisintegration of Li^6 has a threshold at 5 Mev photon energy and then goes to zero again at 20 Mev. If the process in this energy range is considered to be a simple separation of an outer neutron or proton from the alpha-particle core of the Li^6 nucleus by the electric dipole interaction with the radiation, it is shown that the alpha-particle core can not be considered inert in this energy range, even though the core would not disintegrate below about 20 Mev photon energy. One reason the core may not be considered inert is that the integrated cross section predicted under this assumption is much larger than the experimental result.

An explanation for the small integrated cross section obtained experimentally is presented here. An indirect process is investigated, in which the core may be excited by photons in the energy range below threshold for disintegration of the core. Then the core decays back to the ground state and by interacting with an outer neutron or proton, the latter is ejected. The excited state of the core is an intermediate state and energy conservation does not apply to the intermediate state in second order perturbation theory.

The net effect of the indirect process is to decrease the cross section for ejecting an outer particle and increase the cross section for disintegration of the core. The indirect process may also cause the cross section to go to zero at 20 Mev by interference.

Microfilm $2.50; Xerox $4.80. 95 pages.

COLLISION PROCESSES IN MIXTURES OF MERCURY VAPOR AND FOREIGN GASES

(L. C. Card No. Mic 59-5982)

Donald E. Cunningham, Ph.D.
Case Institute of Technology, 1959

A quantitative study of collision processes occurring in a mercury vapor - foreign gas mixture is made. The aim of the study is to determine the types and probabilities of the collisions undergone through application of the theory of Ellett, Olsen, and Petersen. This theory relates the polarization properties observed in mercury resonance radiation to the magnetic field and pressure of foreign gas in the region in which the resonating mercury atoms are located. Measurements of the polarization as a function of pressure of foreign gas at various magnetic fields are performed. The depolarizing effect of ten foreign gases is measured.

The polarization, itself, is measured by the method of Cornu. Intensity matching is accomplished through use of a photomultiplier tube.

The theory of Ellett, Olsen, and Petersen has been checked and describes the behavior of the polarization well. The conclusion reached is that adiabatic depolarizing collisions do not occur in mercury vapor - foreign gas systems. Microfilm $2.50; Xerox $4.40. 83 pages.

MODIFICATIONS OF A VAN DE GRAAFF ACCELERATOR FOR ION BUNCHING

(L. C. Card No. Mic 59-5509)

William Elijah Dance, Ph.D.
Louisiana State University, 1959

Supervisor: Professor D. C. Ralph

Modifications of a 1 Mev Van de Graaff accelerator to meet the requirements of an added ion bunching system are described in moderate detail. An extensive vacuum chamber, previously designed to allow for increased length of the ion beam path and to accommodate certain equipment required for the bunching of ions, has been tested, assembled, and installed. A beam analyzing magnet has been designed and constructed for selecting the monatomic ion beam. Adjustment in the angle of the pole piece edges of this magnet provides a small degree of fringe field focusing of the beam. Field shaping for proper beam focusing of the existing bunching magnet is described in some detail. By means of the technique described, focusing in the plane of the field gap was adequate for preliminary ion bunching. Corona spray charging of the electrostatic generator belt has been replaced with a more stable, induction charging system whereby the charge is carried to the high voltage shell on wire paper staples in the belt. Particular attention is given to modifications of the existing ion source to fulfill the requirements of the added ion bunching equipment. Preliminary testing of the new source indicates a maximum output of approximately 500 microamperes of positive ion current, with a favorable H_1^+/H_2^+ ratio. Apparatus and alterations introduced into the system for convenient beam alignment are discussed, and further measures taken to enhance the reliability of the Van de Graaff generator are mentioned.

Microfilm $2.50; Xerox $3.00. 57 pages.

THE MEASUREMENT OF RADIATIVE ELECTRON CAPTURE AND THE NUCLEAR SPECTRA OF CE-144 AND ITS DECAY PRODUCTS

(L. C. Card No. Mic 59-5378)

Werner Sigmund Emmerich, Ph.D.
The Ohio State University, 1953

The continuous energy electromagnetic spectra occurring in radiative orbital electron capture were investigated by means of single channel scintillation spectrometers. The radioactive isotopes Fe^{55}, A^{37}, and Ni^{59}, all of which disintegrate by orbital electron capture directly to the ground state of their product nuclei without emission of gamma radiation, were selected for study in this work. The relative probability of photon emission dP with respect to the total K capture probability P_k is the energy interval dE, except at low energies, which is given by

$$\frac{dP}{P_k} = \frac{1}{137\pi}(1 - E/E_0)^2 \; E \; dE$$

where E is the energy of the photon in mc^2 units and E_0 the upper energy limit. E_0 may be obtained by plotting $(N/E)^{1/2}$ against E, where N is the observed activity per unit energy interval. In accordance with the calculated distribution, the plot should be linear and intersect the axis at E_0, in analogy to a Kurie plot. The total radiation probability per K capture is approximately given by

$$\int \frac{dP}{P_k} = \frac{1}{12x137\pi}(E_0)^2$$

These calculations were carried out under the assumption that the transition is allowed. The Fe^{55} was produced by neutron irradiation of stable iron in the Oak Ridge National Laboratory reactor by (n,γ) reaction on Fe^{54}. Before measurements were started, the material was aged for five years following irradiation to allow for the disintegration of 46 day Fe^{59}, formed by irradiation of Fe^{58}. A chemical separation of iron was performed by ethyl ether extraction to remove radioactive impurities. The A^{37} activity was obtained by (n,α) reaction on Ca^{40}. Thirty grams of calcium oxide were irradiated with neutrons at the Brookhaven National Laboratory reactor for a period of two months with a flux of about 4×10^{12} neutrons/sec/cm^2. The argon was removed after irradiation by reaction of the calcium oxide with water that was saturated with common argon. The gaseous products were collected in an evacuated vessel. A half-life measurement carried out on electromagnetic radiation emitted by the gas showed a half-life of 35 days, in accordance with the results previously obtained for A^{37}. The activity of Ni^{59} was produced by (n,γ) reaction on Ni^{58} in the NRX reactor operated by Eldorado Mining, Ltd. at Chalk River, Canada. A quantity of 40 grams of nickel metal was irradiated for a period of 28 days with a flux of 1.2×10^{13} neutrons/sec/cm^2.

Two scintillation spectrometers were designed for the measurement of radiative electron capture. The first model served as pilot instrument and was used in preliminary experiments to test the feasibility of detecting radiative electron capture. It consisted of a thallium activated sodium iodide crystal mounted in an argon atmosphere on top of an RCA type 5819 photomultiplier tube. The output of the photomultiplier was amplified in a three stage polarized pulse amplifier. The pulse selection was attained by a single channel pulse height analyzer with fixed threshold. It consisted of an upper gate and a lower gate, each followed by a univibrator, an anti-coincidence mixer, and a discriminator stage. The pulse height scanning was accomplished by varying the voltage on the photomultiplier tube. In this type scanning, the voltage setting varies almost logarithmically with the energy, making possible measurements over a wide range of energies. Furthermore, the window width remains at a constant percentage for all settings, similar to the condition that exists in magnetic beta ray spectrometers. The instrument was calibrated with I^{131}, Ce^{144}, Au^{198}, Cu^{64}, Cs^{137}, Mn^{54}, and Zn^{65}. The radiative electron capture spectrum of Fe^{55} was then used to test the instrument for its ability to measure continuous energy spectra. The resultant data were compared to a theoretical curve calculated for an end point energy of 220 kev. Agreement within statistical variation was attained down to an energy of 80 kev. The data were then plotted in the form of a linear graph. The end point energy was established to be 217 ± 10 kev.

The second scintillation spectrometer was designed with electronically stabilized voltage supplies, and a window amplifier was incorporated into the pulse height analyzer design. The instrument consisted of a factory mounted sodium iodide crystal, an RCA type 5819 photomultiplier

tube, a four-stage linear pulse amplifier with two negative feedback loops, and a cathode follower output stage. The pulses were fed into a threshold discriminator incorporating a constant current tube. The threshold was adjustable between three and 103 volts. The excess pulse amplitude was amplified ten times in a window amplifier, which was followed by an upper and a lower gate, univibrators for each gate, an anticoincidence mixing circuit, and a discriminator-amplifier output stage. The pulse height scanning could be accomplished either by varying the photomultiplier voltage, giving logarithmic energy scanning, or by varying the threshold setting, giving linear scanning. In the energy range from 300 kev to 1300 kev, the detection efficiency of the crystal for electromagnetic radiation was determined empirically with the gamma rays of Hg^{203}, I^{131}, Au^{198}, Cs^{137}, Zn^{65}, and Co^{60}. The absolute counting rate of the Co^{60} sample was known and served as a calibration standard. The other sources were standardized by comparison of their beta ray spectra with that of Co^{60} by means of absorption techniques.

In order to account for the distortion introduced by the Compton scattering into the intensity distribution of the radiative capture spectra, the Compton distributions were measured for a number of gamma rays in the energy regions of interest. In addition to some of the above mentioned activities, the radiations of Be^{7} and Mn^{54} were utilized for the analysis. The empirical correction was attained by dividing the radiative capture spectrum into a number of energy sections, each corresponding in width to the experimentally observed half-width of a gamma ray peak in the instrument. With the highest energy region as a starting point, the corresponding gamma ray peak was normalized to the intensity of that section of the radiative capture spectrum, and the contribution due to Compton interaction from the gamma ray was subtracted out at lower energies.

This procedure was repeated step by step always for the highest energy section which remained uncorrected. The resultant net intensity was then subjected to further correction for crystal efficiency as outlined above.

After the empirical corrections had been applied to them, the radiative capture spectra were plotted in linear form as $(N/E)^{1/2}$ against E. The end point energy for the spectrum of A^{37} was 815 ± 20 kev. The plot followed a straight line from its end point down to an energy of 320 kev, which was the lower limit to which the correction procedure was carried out. The Ni^{59} spectrum was analyzed in the same manner as the A^{37} spectrum, and the linear plot was prepared. The experimental end point energy was 1065 ± 30 kev. As in the case of A^{37}, the experimental points followed a straight line down to an energy of 320 kev. The ratio of the total radiative capture to ordinary electron capture was also determined for Ni^{59} and found to be $(1 \pm 0.5) \times 10^{-3}$, which may be compared to the calculated value of 8×10^{-4}. This ratio was obtained from the observed intensity of the radiative capture spectrum and the total Ni^{59} activity was calculated by assuming a neutron capture cross section of 4.17 barns and a half-life for Ni^{59} of 7×10^{4} years.

From the disintegration energy and the half-life of Ni^{59} it follows that the log ft value of the transition is about twelve, possibly a second-forbidden transition. A spin change of two, as expected from the shell model, may be inferred from the measured spin of 7/2 of Co^{59} and of 3/2 for the 31st neutron in Ni^{59}. The above results indicate

TABLE I

Internal Conversion Lines in the Disintegration of Ce^{-144} and Pr^{-144}

Line Energy in kev	Relative Intensity	Assignment		Gamma Energy in kev	Shell-Ratio		Multipole Radiation
		Element	Shell		K/L	L/M	
92.2	100*	Pr	K	134	8	4	M1
127.8	12		L				
133.1	3		M				
38.5	49	Pr	K	81	5	9	M2
74.0	9		L				
79.2	1		M				
27.0	11	Pr	L	34		3	
32.5	4		M				
58.7	4	Pr	K	100			
99.0	1		M				
46.6	3	Pr	L	53			
34.2	11	Pr	L	41		11	
39.6	1		M				
52.7	7	Pr	K	94			
88.0	trace		L				
16.8	4	Nd	K	60	1		
53.3	4		L				
29.2	12	Pr	L	Auger		2	
34.2	6		M				

*The intensities of the interval conversion lines are expressed in per cent of the 92 kev line.

that the shape of the radiative capture spectrum is in accord with the formula derived for allowed transitions, so that the shape of the spectrum appears to be independent of the type of transition involved in the disintegration of Ni^{59}. Since the transition energy in Ni^{59} exceeds 2 mc^2, positron emission is possible in the decay. A search for annihilation radiation yielded negative results, indicating that the branching ratio should be less than 10^{-5}. This agrees with calculations that predict a positron branching of only 10^{-12} in case of a second forbidden transition.

The nuclear spectra of Ce^{144} and Pr^{144} were investigated by means of a permanent magnet photographic spectrograph and a scintillation spectrometer. The internal conversion lines were measured between 15 kev and 150 kev energy. The line intensities were determined with a photodensitometer. Energies and relative intensities of the lines are found in Table I, where the intensity of the 92 kev line is taken as 100. Also shown are the associated gamma ray energies and shell ratios where available.

The K/L ratios which are obtained for the 134 kev and the 81 kev transitions are in agreement with an assignment of M1 and M2 transition, respectively. The scintillation spectrometer observations indicate an intensity ratio between 10 and 20 for free gamma emission of these two transitions. With the relative intensity of the K conversion peaks being 100/49, the ratio for the total transition intensity is about four, assuming a K conversion coefficient of 0.5 for the 134 kev gamma ray.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The observed intensity of the 34 kev line was 17, whereas the calculated value for the LKM Auger line was six. The excess was interpreted as L line of a 41 kev gamma ray.

The existence of a 175 kev level was supported by the energy balance of 134 kev and 41 kev as well as 81 kev and 94 kev. A direct transition to the ground state was not observed. The K conversion line of such a transition almost equals the 133 kev M line in energy. Since the line is not excessively intense, a direct transition of 175 kev does not appear abundant.

A more reliable determination of the branching ratio in Pr^{144} than is possible from Kurie plot analysis was obtained from a measurement of the relative intensity of the 695 kev gamma transition and the 2.98 Mev beta transition. This gave an intensity of 1.25 ± 0.2 per cent for the 695 kev gamma transition. From the relative intensities of the 695 kev, 1480 kev, and 2185 kev gamma transitions, the branching ratios of the Pr^{144} beta radiations were established. They are 97.3 per cent, 0.8 per cent, and 1.9 per cent for the 2.98 Mev, 2.28 Mev, and 0.8 Mev beta rays, respectively. This yielded log ft values of 6.5, 8.1, and 6.0, indicating that the 0.8 Mev beta ray falls on the borderline between allowed and first forbidden transitions. It is plausible that the transition is allowed considering the high ft values observed for first forbidden transitions in this region of the isotopic table.

It may be possible that the (1-) level of 2185 kev is third or higher among the excited states in Nd^{144}, since the second excited states in even-even nuclei occur generally as (2+) or (4+) states. A single additional state with (4+) would be fed with insufficient intensity either through beta or gamma transitions in the present investigation.

The branching ratios in the Ce^{144} beta transitions were obtained from a comparison of the 134 kev and 81 kev internal conversion lines. From the known value of 70 per cent for the abundance of the 304 kev beta transition to the ground state, the comparative measurements yielded a value of 22 per cent for the intensity of the 175 kev beta transition and three per cent for the 223 kev beta transition. These values, being derived from the relative intensity of gamma rays, lead to log ft values of 7.2 and 8.2, respectively. A direct observation of the beta spectra was not attempted owing to interference from internal conversion lines in this region of energy.

Microfilm $2.50; Xerox $6.20. 128 pages.

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A THEORETICAL STUDY OF NUCLEAR LEVEL DENSITIES

(L. C. Card No. Mic 59-5553)

Jackson Rea Herring, Ph.D.
The University of North Carolina, 1959

Supervisor: Eugen Merzbacher

Level densities of compound nuclei have been investigated using the statistical model. The approximations of the statistical model were also studied and found to be adequate, at least for the purpose of estimating the order of magnitude of the level densities. A basic ingredient entering the level density formula is the density of independent particle states, for neutrons and protons, at their Fermi energies. The independent particle level scheme was taken to be that of a Fermi gas with the following refinements pertinent to the nucleus: 1) the presence of a nuclear surface; 2) the effects of the finiteness of the potential well in which the nucleons move; and 3) the effects of a shell model pairing energy for the independent particle level scheme.

The main effect of a nuclear surface is to give the independent particle level scheme a shell structure. An attempt was made to get a sensible formula, based on the W.K.B. approximation, which would give the independent particle level densities (at the Fermi energy) a shell structure. The W.K.B. approximation was found to be inadequate for this purpose; the number of independent particle states at a particular energy which it gives contains too many states of large angular momentum. The only satisfactory way of obtaining a sensible shell structure for the independent particle states seems to be one constructed from a particular shell model.

The finiteness of the potential well was found to have two effects: 1) a slight increase in the density of independent particle states at the Fermi energy; and 2) the presence of only a few levels above the Fermi energy. The first of these effects is negligible--considering the uncertainty in the nuclear radius--but the second does change the level density formula significantly at high excitation energies. General formulas were developed to treat the finite well effect, and as an example of the theory these were applied to two nuclei. Little experimental data as yet exists on this point.

The inclusion of a shell model pairing energy in the level density formula was found to lower the density of states of the compound nucleus appreciably. General formulas were developed to treat this effect. A comparison of the theory with the existing data on level densities indicates that residual interactions at excitation energies equal to the binding energy of the last neutron in the nucleus are weak. Microfilm $2.50; Xerox $4.00. 72 pages.

STOPPING POWER OF THIN ALUMINUM FOILS FOR 12 TO 127 KEV ELECTRONS

(L. C. Card No. Mic 59-6202)

Ford Kalil, Ph.D.
Vanderbilt University, 1959

Supervisors: R. D. Birkhoff, H. H. Hubbell, Jr., and W. G. Stone

The stopping power of aluminum for monoenergetic electrons at several energies between 12 and 127 KeV has been determined by calorimetric methods. The electron beam from a Cockroft and Walton type accelerator impinged normally on a thin foil mounted on a ring which was in turn supported by a set of series connected thermocouples. The ring and foil could be precooled below room temperature by Peltier cooling. The rate of change with time of foil temperature was noted as the temperature

passed through room temperature, where heat losses could be neglected. Calibration was accomplished by reducing the beam energy until complete absorption took place. Under this condition the rate of drift per unit power could be obtained and used to determine beam power expended at higher energies. Foil thicknesses of 50.3 $\mu g/cm^2$ and 107.8 $\mu g/cm^2$ were determined by direct weighing on a modified electrobalance. When path length corrections due to multiple scattering were made, stopping powers in good agreement with the Bethe theory were obtained.

Microfilm $2.50; Xerox $6.20. 130 pages.

RADIOACTIVITY OF PROMETHEUM

(L. C. Card No. Mic 59-5363)

John Kelley Long, Ph.D.
The Ohio State University, 1953

The 2.3-year activity of Pm^{147}, the 5.3-day activity of Pm^{148}, and the 2-day activity of Pm^{149} are well established. A 2.7-hour activity without a mass assignment has also been attributed to prometheum, and a 27.5-hour activity has recently been assigned to Pm^{151}.[1] The availability of enriched natural isotopes of neodymium in high purity has provided this investigation with a means for further study of the prometheum isotopes.

Oxides of enriched neodymium isotopes were supplied by the AEC. Mass analyses and spectroscopic analyses of these samples were also furnished by the supplier. The enriched samples were bombarded with 6 to 7 Mev protons. The decay of the products was followed on conventional counting equipment. The sign of the charge of the beta particles was determined by magnetic deflection. Bombardment of each of the enriched isotopes in turn for three to seven hours disclosed prominent activities of 2.7 hours, 5.3 days, 40 days, 300 days, and 3.5 years.

The 2.7-hour activity has been observed previously as a result of bombardment of neodymium with protons and deuterons. In the present investigation it was produced from three neodymium samples containing different isotopic abundances. The 5.3-day activity from the reaction $Nd^{148}(\underline{p},n)Pm^{148}$ was also observed in these samples. By means of the 5.3-day activity, the observed intensities of the 2.7-hour activity were adjusted for small variations in time of bombardment, sample size, and beam strength. With these adjustments, the intensities of the 2.7-hour activity were 3.8, 7.4, and 20 in samples where the per cent abundances of Nd^{150} were 3.9, 5.6, and 94.8 respectively. The adjusted intensities of the 2.7-hour activity correspond more closely with the abundances of Nd^{150} in the samples than with the abundances of any other isotope. These intensities, together with the bombarding energy, indicate that the 2.7-hour activity was formed by a $(\underline{p},n)$, $(\underline{p},\gamma)$, or $(\underline{p},\alpha)$ reaction on Nd^{150}.

The $(\underline{p},\alpha)$ reaction on Nd^{150} is immediately ruled out because it would necessarily yield the 10.8-day Nd^{147} activity, which was not observed in any of the proton bombardments. The 27.5-hour activity of Pm^{151}, which, with protons, would be produced by a $(\underline{p},\gamma)$ reaction, was present, if at all, in very low intensity. This observation would indicate that a $(\underline{p},\gamma)$ reaction with 7 Mev protons on Nd^{150} is not a prominent one. The 2.7-hour activity may therefore be assigned to Pm^{150} in accordance with the reaction $Nd^{150}(\underline{p},n)Pm^{150}$.

The particle radiation associated with the 2.7-hour was negative in sign. The beta-end point was observed at 2.9 ± 0.1 Mev by magnetic spectrometer measurements. A 270-kev internal conversion electron was also observed with the 2.7-hour activity.

As a result of proton bombardment, an activity with a half-life of 40 ± 2 days was observed in four neodymium samples having different isotopic abundances. Chemical separation showed that this 40-day activity belonged with the rare earth group. By the use of the 5.3-day activity, the observed intensities of the 40-day activity were adjusted for small variations in sample size, beam strength, and time of bombardment. With these adjustments, the intensities of the 40-day activity were 0.09, 1.2, 1.5, and 89.9 in samples where the per cent abundances of Nd^{148} were 0.08, 1.25, 1.42, and 89.9. The intensities of the 40-day activity in the four samples could not be matched with the per cent abundances of any other neodymium isotope. These intensities indicate that the 40-day activity was formed by a reaction of protons on Nd^{148}. Since the 4.6-hour Pr^{145} was not observed, a $(\underline{p},\alpha)$ reaction on Nd^{148} is regarded as improbable. Likewise, since the 2-day Pm^{149} was not observed, a $(\underline{p},\gamma)$ reaction is also improbable. The 40-day activity may therefore be assigned to Pm^{148}, formed by the reaction $Nd^{148}(\underline{p},n)Pm^{148}$.

The 40-day activity is accompanied by negatively charged beta particles of 1.7 ± 0.1 and 0.6 ± 0.1 Mev, and gamma radiation of about 0.54 Mev, as shown by absorption measurements of the radiations in aluminum and lead.

Three activities of the order of one year were observed. The enrichments from which they were formed indicate that a 300-day activity may be assigned to Pm^{142}, a 330-day activity to Pm^{143}, and a 350-day activity to Pm^{144}. All three have a high ratio of electromagnetic to particle events, and presumably decay by electron capture. Neodymium K X-rays have been identified with the 300-day Pm^{142}. A 0.6 ± 0.1 Mev internal conversion electron is apparently associated with the 350-day Pm^{144}.

An activity of at least 3.5-years half-life was observed as a result of both deuteron and proton bombardments of enriched Nd^{146}. The new 3.5-year activity is easily distinguished from the previously known 2.3-year Pm^{147} by the energy of the particles involved in the decay. The 3.5-year Pm^{146} emits particles of maximum energy 0.75 ± 0.1 Mev, whereas the 2.3-year Pm^{147} emits particles of maximum energy 0.23 Mev. Samples of enriched Nd^{146} bombarded with 10-Mev deuterons revealed both the 2.3- and 3.5-year activities. Proton bombardments of Nd^{146} resulted in the formation of the 3.5-year activity without any of the 2.3-year activity. With the bombarding energies used, the only explanation of the deuteron and proton bombardments is that the 3.5-year activity must be assigned to Pm^{146}. It is formed by the reaction $Nd^{146}(\underline{d},2n)Pm^{146}$ in the one case, and by the reaction $Nd^{148}(\underline{p},n)Pm^{146}$ in the other.

The Pm^{146} activity was not formed in sufficient quantity to measure the particle spectrum. Even without such measurements, considerable evidence is available to indicate that the particle is a negatively charged beta particle rather than an internal conversion electron. First, the maximum energy of the particle is 0.75 Mev, which is rather high for an internal conversion electron except in cases where the conversion coefficient is low. The low

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

ratio of electromagnetic to particle counts indicates that a low conversion coefficient is not possible. Moreover, the only observable gamma-ray has 0.45 Mev, considerably less than the particle energy. Second, aluminum absorption curves for the activity have the shape characteristic of beta particles rather than internal conversion electrons.

If the Pm^{146} decays by negatively charged beta particles, Sm^{146} ought to decay by alpha emission. The search for an alpha emitter among the decay products of Pm^{146} was unsuccessful. This indicates that if Pm^{146} decays to an alpha-emitting Sm^{146}, the Sm^{146} must have an extremely long half-life. Microfilm $2.50; Xerox $3.60. 61 pages.

1. Hollander, J. M., Perlman, I., and Seaborg, G. T. "Table of Isotopes," Rev. Modern Phys., 25 (1953), pp. 562–63.

Abstract published by special arrangement with The Ohio State University.

LIFETIME OF K^+ MESONS

(L. C. Card No. Mic 59-5205)

Robert W. Motley, Ph.D.
Princeton University, 1958

This thesis reports measurements of the mean lives of the positive K mesons, K_{μ_2}, K_{π_2}, and K_{π_3}. These mesons were created at the Brookhaven Cosmotron by the interaction of 3 Bev protons with nuclei in copper and gold targets. Particles emerging at an angle of 60° to the proton beam were focussed and momentum analyzed. Positive particles of momentum 480 ± 50 Mev/c were selected and brought to a focus at a counter array 15 feet from the target. Identification of K mesons was accomplished by range and velocity measurements using scintillation and Cerenkov counters. Auxiliary counters identified the K mesons on decay into the modes K_{μ_2}, K_{π_2}, and K_{π_3}. Timing measurements were performed by placing counter pulses on a fast oscilloscope trace. The lifetimes found and their standard deviations follow:

$$\tau K_{\mu_2} = 11.7^{+.8}_{-.7} \times 10^{-9} \text{ seconds}$$

$$\tau K_{\pi_2} = 12.1^{+1.1}_{-1.0}$$

$$\tau K_{\pi_3} = 11.8^{+.8}_{-.7}$$

$$\tau K_L = 12.15 \pm .30$$

With 90 % confidence the lifetimes of the K_{π_2} and K_{π_3} differ by less than 17 % of their mean.

Microfilm $2.50; Xerox $5.80. 116 pages.

A THEORETICAL STUDY OF THE PROPAGATION OF HIGH-ENERGY MU-MESONS IN THE ATMOSPHERE

(L. C. Card No. Mic 59-5654)

Joseph Addison Smith, Ph.D.
University of Missouri, 1959

Supervisor: Professor Nelson M. Duller

This work is a study of the propagation of very high-energy mu-mesons in the atmosphere. In Chapter I two distinct sets of calculations are made leading to the integral mu-meson intensity at ground level. The first calculation assumes an $E_\pi^{-8/3}$ pi-meson differential production spectrum and leads to an expression of the integral mu-meson intensity containing an infinite series. Curves are graphed showing the intensity as a function of zenith angle with the simplifying assumption that the absorption mean free paths for primary cosmic rays and for pi-mesons in the atmosphere are the same. The second calculation assumes an E_π^{-3} pi-meson differential production spectrum, and, with the use of the Weddle's Rule approximation, the integral mu-meson intensity is displayed formally in terms of elementary functions as a sum of only six terms. Curves are graphed for the intensity as a function of zenith angle for various physically interesting values of the absorption mean free path of pi-mesons in the atmosphere.

The remarkable feature of all of the curves displayed for both calculations above is the appearance of a single maximum at angles away from the vertical. This is in contrast to the very nearly $\cos^2\theta$ angular dependence of the total mu-meson intensity observed at ground level.

In Chapter II variations in atmospheric parameters and the subsequent effects on the very high-energy integral mu-meson intensity are considered. A new model of the atmosphere and a new three term regression equation are introduced to replace those conventionally used. The new model of the atmosphere utilizes atmospheric parameters which as a group are much more readily measured than are the conventional parameters, and the new regression equation, in contrast to the conventional one, can be applied not only to vertically incident mu-mesons, but also to those at zenith angles away from the vertical. The new regression coefficients are calculated from the theory employing the E_π^{-3} pi-meson differential production spectrum and are displayed formally in terms of elementary functions. Curves are graphed showing the behavior of each regression coefficient as a function of zenith angle.

Microfilm $2.50; Xerox $7.60. 165 pages.

PHYSICS, SOLID STATE

CYCLOTRON RESONANCE IN ANTIMONY

(L. C. Card No. Mic 59-6974)

William Ross Datars, Ph.D.
The University of Wisconsin, 1959

Supervisor: Dr. Richard N. Dexter

A study of cyclotron resonance in highly-purified single crystals of antimony is presented. Microwave resonance

techniques were used at a frequency of 24,000 Mc/s and at liquid helium temperatures. In all experiments shiny crystal surfaces which contained the trigonal plane were used to form part of the end wall of a cylindrical microwave cavity. Linearly polarized radiation was used in experiments in which the magnetic field was parallel to the crystal surface. A plot of microwave absorption as a function of magnetic field strength exhibited resonance minima at fundamental and harmonic values of the cyclotron magnetic field. Many of the properties agreed with those predicted by the theory of Azbel and Kaner and substantially verified the validity of this theory. The use of circularly polarized radiation detected the separate effects caused by electrons and holes when the magnetic field was perpendicular to the crystal surface. The high-field absorption was much larger for holes than for electrons. The tilted-ellipsoidal model is used to represent the electronic Fermi energy surface. The anisotropy of the cyclotron masses establishes the validity of this model and circular polarization data suggests that the carriers on the tilted-ellipsoidal Fermi energy surface are electrons. The mass parameters of one of the ellipsoids are $m_1 = 0.05m_0$, $m_2 = 1.03m_0$, $m_3 = 0.53m_0$ and $m_4 = -0.67m_0$. These values are in good agreement with those obtained by Shoenberg in a de Haas-van Alphen experiment.

Microfilm $2.50; Xerox $5.00. 99 pages.

SHOCK-WAVE COMPRESSION OF IRON AND BISMUTH

(L. C. Card No. Mic 59-6708)

Lloyd Eugene Gourley, Jr., Ph.D.
The University of Texas, 1959

Supervisor: Dr. D. S. Hughes

A helium gun was used to propel metal projectiles against targets of the same materials. Pressures produced by impact were varied by varying projectile velocities. The method produced pressures up to somewhat over 100 kilobars, thus overlapping the lower part of the range of pressures which can be produced by detonation of high explosives. Of particular interest was the range of pressures intermediate between the highest which can be produced statically and the lowest which can be produced by explosives.

A condenser micrometer was used to detect motion of the free surface of the target. This method permitted examination of the motion in greater detail than could reasonably be accomplished by other methods which have been used.

Elastic and plastic waves were observed in iron and in bismuth. Assuming the Rankine-Hugoniot shock conditions, pressures and compressions were computed. Pressure-compression data for iron were obtained for intermediate pressures not previously investigated. Phase transitions in bismuch were observed for pressures up to about 40 kilobars. Microfilm $2.50; Xerox $3.80. 69 pages.

DEHYDRATION STUDIES ON BOVINE SPERMATOZOA

(L. C. Card No. Mic 59-5630)

Marion Merlyn Anderson, Ph.D.
University of Missouri, 1959

Supervisor: C. P. Merilan

Freezing points of various glycerol-egg yolk-sodium citrate mixtures showed marked deviations from freezing points of glycerol-water solutions.

Four general dehydration methods were attempted on bovine spermatozoa.

1. Freeze-drying. In this method the samples were frozen and dried from the solid state under vacuum levels of 75 microns Hg. and 0.001 micron Hg. Diluents included potassium citrate, egg yolk-potassium citrate, egg yolk-sodium citrate, and egg yolk-skim milk. Sufficient glycerol was added before freezing to give an 8 per cent final concentration. Pre-freezing treatment variations included shell-freezing, centrifugation, and centrifugation into a mixture of freons (11, 113, and 114) and practical heptane (Eastman Kodak Chemical P2218). Drying temperatures ranged from -3° C. to -79° C. or drying was begun at -79° C. and the sample allowed to warm slowly.

2. Solid-liquid displacement dehydration. Frozen semen was immersed in an organic liquid at -79° C. and stored with occasional replacement of the liquid. After the sample was considered essentially free of H_2O, the fluid was removed either by evaporation at storage temperatures or by rapid evaporation under vacuum at warmer temperatures. Organic liquids used were acetone, trimethyl amine, dimethyl amine, ethyl chloride, ethylene oxide, and methyl mercaptan.

3. Liquid-gas displacement dehydration. A liquified gas (usually ethane) was used to replace the water in spermatozoa. The sample was then warmed above the critical temperature of the gas, the pressure slowly released, and the gas allowed to evolve.

4. Solid-liquid-gas displacement dehydration. In this technique, solid-liquid displacement followed by liquid-gas displacement, the H_2O of frozen spermatozoa was extracted at -79° C. with acetone, the acetone replaced with liquefied ethane, and the ethane allowed to evolve as a gas.

Rehydration media were distilled water, 3 per cent sodium citrate, 3 per cent potassium citrate, Beckman 3501 pH 7 buffer, egg yolk-sodium citrate diluter, aged bacterial contaminated egg yolk-sodium citrate diluter, skim milk, egg yolk-skim milk diluter, and solutions of adenosine triphosphate. In these various trials no motile spermatozoa were observed after dehydration and subsequent reconstitution.

A method utilizing the temperature difference between sample and exterior bath was developed to enable estimation of sublimation rates during lyophilization of spermatozoa. Preliminary results indicate differences between bulls and/or ejaculates in sublimation characteristics of the semen. Microfilm $2.50; Xerox $3.60. 62 pages.

ALTERATIONS IN RENAL HEMODYNAMICS AND ANTIDIURETIC HORMONE RELEASE FOLLOWING ACTIVATION OF THE VOLUME RECEPTOR MECHANISM IN THE DOG

(L. C. Card No. Mic 59-6822)

Robert Alan Baratz, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

There has recently been demonstrated the existence of stretch receptors in the left atrium which respond to change in volume of the extracellular fluid, independent of changes in tonicity. There are two possible mechanisms whereby this volume control can be explained: 1) a direct action on renal hemodynamics or 2) a neural or hormonal control of antidiuretic hormone (ADH) release. Simultaneous changes in renal hemodynamics and antidiuretic hormone activity of the plasma were measured under various conditions calculated to activate the volume receptor mechanism in the dog. The series studied necessarily produced little, if any, stimulation of the osmoreceptors, and included generalized decrease and increase in the extracellular fluid volume by hemorrhage and plethora respectively, and selective decrease and increase in the vascular volume of the thorax by positive and negative pressure breathing respectively.

Antidiuretic hormone was assayed using rats rendered unconscious with ethanol and under constant water load. All injections of standards and unknowns were intravenous and the criterion of potency was change in the specific gravity of the rat's urine expressed as antidiuretic index. The sensitivity of the assay was such that small dose changes of reference vasopressin, and moderate changes in endogenous circulating ADH in any one assay animal could be differentiated.

The results of the experiments on hemorrhage and positive pressure breathing show the characteristic cardiovascular responses to the imposed stress. There was a marked depression of renal function as well as a highly significant increase in the level of circulating antidiuretic hormone. It appears that the volume receptor mechanism may be a part of the overall compensatory response to a general or selective decrease in the extracellular fluid volume.

The generalized isotonic expansion of the extracellular fluid with 6% dextran produced few cardiovascular changes. A significant diuresis and increase in effective renal plasma flow following plethora was noted, along with a suggested increase in glomerular filtration rate. There was a suggestion also of a decrease in the circulating level of ADH, but this was not statistically significant. Here, the sensitivity limits of the bioassay may have been an important factor.

The elicitation of a diuresis with negative pressure breathing is not as consistent as previous reports indicate. Experimental procedures were altered with regard to anesthesia, degree of hydration and position of the animal, in order to produce more uniform urine flow responses to negative pressure breathing. The results of this series of experiments were arbitrarily divided into those producing a diuresis of 25% or more over control flows and those producing an antidiuresis of 25% or more. No significant change in any parameter was noted in either group except for a consistent decrease in central venous pressure during negative pressure breathing. Renal hemodynamics and the circulating level of ADH exhibited no statistically significant change.

The mechanism to explain the action of the volume receptors following isotonic expansion of the extracellular fluid volume is not clearly defined. There is no statistically significant action on renal hemodynamics and any effect on the release or inhibition of antidiuretic hormone cannot be detected because of the limiting sensitivity of the bioassay. The action of the volume receptors in these situations appears then to be subdominant to the control of body fluid volume via the osmoreceptors.

Microfilm $2.50; Xerox $5.00. 97 pages.

FACTORS INFLUENCING THE DEVELOPMENT OF DECIDUOMATA IN PUBERAL AND ADULT RATS

(L. C. Card No. Mic 59-6630)

Vincent Joseph De Feo, Ph.D.
The Ohio State University, 1954

A deciduoma is a uterine tissue which is identical to that of the maternal portion of the placenta. Using a technique which enables the growth of these deciduomata to take place experimentally, the author was able to study the influence of various factors on the formation of this tissue in the rat.

A comparison was made between the puberal and the adult rat regarding the ability for deciduoma formation. The influence of acute starvation on the deciduoma response was also determined.

Deciduomata can be formed only when the uterus is under the influence of progesterone. This progesterone was made available from the animals' own corpora lutea during the 'induced state' of pseudopregnancy. This state was achieved by stimulation of the cervix with a glass rod on the day of estrus (determined by vaginal smear technique).[1] This day was regarded as day 0 of pseudopregnancy. Four days later the uterus was traumatized for deciduomata formation by insertion of a burred needle into the uterine lumen and subsequent irritation (the entire endometrium from the uterotubal junction to the bifurcation was scraped as the needle was withdrawn). After such a procedure, a transformation of cells occurs in the uterine

stroma. The change in cellular morphology is identical to that which is found in the region of an ovum that has descended into the uterus and has become implanted.[2] On the ninth day of pseudopregnancy the animals were autopsied. The ovaries, adrenals, and uterus were dissected and weighed. The weight of the uterus served as an index of the degree of deciduoma formation possible under the various experimental conditions. The animals used were female Sprague Dawley rats obtained from the Holtzman Company in Wisconsin. They were incorporated into the experiment either as adults (4 months of age) or as 'maturing rats' taken at the completion of either the first, second, third, fourth, fifth, or sixth estrus cycle following vaginal opening. Some of these animals were subjected to acute starvation (complete withdrawal of food) as follows: (a) starvation during the 4 days of pseudopregnancy preceding the trauma or (b) starvation during the 5 days (days 4 to 9) following the trauma, the period of actual deciduoma growth. (The following starvation periods were also studied in the young rat at the pseudopregnancy induced at the first estrus: days 0 to 3, days 0 to 2, days 0 to 1, days 1 to 5, days 2 to 6, days 3 to 7, days 4 to 8, days 1 to 2, days 2 to 3, days 3 to 4, days 2 to 4, and days 4 to 6.)

Deciduoma and Maturity

The results indicated that the puberal animal could give rise to deciduoma at the pseudopregnancy induced at the time of vaginal opening (mean age 37.9±0.22 days). The adult level of response was not attained however, until the animals had reached the sixth estrus cycle (see Table I). No explanation can be offered at present to account for the difference between the puberal and the adult

TABLE I

Cycle	Number Animals	Age Autopsy	Body Wt. Final (g.)	Uterus Wt. (g.)
1	18	47.0±0.84*	140±3.2	2.47±0.08
2	13	56.0±2.14	150±5.6	2.81±0.12
3	9	62.5±1.02	153±3.4	3.42±0.14
4	5	70.3±3.90	175±7.2	3.24±0.31
5	8	69.8±1.92	179±3.9	3.75±0.08
6	7	68.6±1.36	186±3.3	4.03±0.20
Adult	8	4 to 6 mo.	258±3.7	4.29±0.26

*Mean ± standard error

deciduoma response. However, several possibilities exist: (a) the puberal animal may have a reduced corpus luteum activity perhaps as a result of deficient stimulation by the pituitary (luteotrophin); (b) the uterus may be less sensitive to the luteal hormones in the younger animal; or (c) the smaller uteri of the puberal animal may possess a smaller amount of tissue for participation in the decidual response.

Deciduoma and Starvation

The effects of starvation on deciduoma formation depended on the degree of maturation of the animal and on the time of starvation with respect to uterine traumatization. In the adult animal, starvation for the four days prior to trauma (days 0 to 4) gave no interference with the deciduoma reaction, while starvation for the 5 days after the trauma (during the active development of deciduoma) enabled a growth to within 70 per cent on that achieved by the nonstarved animal (see Table II). In the adult, a starvation of 9 days which included both the period prior to trauma as well as the period after trauma, still gave a response of 60 per cent of that of the control.

TABLE II

	Puberal Animal		Adult Animal (4 to 6 mo.)	
Treatment Days Starved	Body Wt. Final (g.)	Uterus Wt. (g.)	Body Wt. Final (g.)	Uterus Wt. (g.)
Nonstarved	140±3.24	2.47±0.08	258±3.7	4.29±0.26
0-4	115±5.74	0.50±0.21	233±3.8	4.04±0.23
4-9	83±3.49	1.07±0.20	195±3.1	2.89±0.32
0-9	---	----	167±3.6	2.08±0.24

The effects of starvation were more pronounced in the puberal animals regarding formation of deciduoma (see Table II). Posttrauma starvation (days 4 to 9 of pseudopregnancy) gave growth which was 40 per cent of that found in nonstarved controls. Pretrauma starvation, however, caused a more serious depression in deciduoma formation. The response here, was only 20 per cent of the control value. These results were statistically significant (t-test). These findings are interesting because apparently the greatest inhibition is achieved, not by the starvation occurring simultaneously with deciduoma growth, but by the shorter starvation taking place before initiation of growth. It was noted that starvation for just days 2 to 4 of pseudopregnancy was as effective in suppressing the deciduoma formation as was the 5-day starvation of the posttrauma period. This finding has been taken to indicate that the pretrauma starvation in some way reduced the uterine sensitivity to trauma and in this manner prevented the response from reaching the normal status. The nature of the proposed loss of sensitivity has not been determined. However, several possibilities may be considered: (a) a reduced pituitary luteotrophin secretion as a result of starvation (the luteotrophin is a known requisite for corpus luteum activity); (b) an increase in adrenal cortical hormones as a result of the stress of starvation (these hormones have been shown to inhibit deciduoma formation if given during the posttrauma period),[3] and (c) a loss of uterine sensitivity as a result of a proposed increase in estrogen titer possibly resulting from failure of estrogen inactivation by the liver during starvation (estrogen during the pretrauma period has been shown to cause loss of uterine sensitivity).[4]

The reduced deciduoma formation achieved during concomitant posttrauma starvation may be attributed to: (a) a greater utilization of food substance for energy with a reduction in that which is available for active growth, or (b) a catabolic action as a result of adrenal cortical hormone activity which might induce withdrawal of deciduomatous tissue at a slightly lower rate than that at which it was being deposited.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Deciduoma and Pseudopregnancy

In another series of experiments, deciduomata were found to exert an influence on the duration of pseudopregnancy in nonstarved puberal rats. The normal pseudopregnant duration in the puberal rat of this strain was 13.1 ± 1.32 days. In the presence of deciduomata the duration of pseudopregnancy was prolonged to 20.2 ± 0.32 days. This approximates the normal gestation interval (21 to 22 days) of the rat.

These findings are not unique since they have been reported for the adult animal.[5,6,7] However, the puberal rat has not been suspected or tested in this way. Furthermore, the finding of a reduced deciduoma response at puberty together with an adult type of "pseudopregnant prolonging ability" for these deciduoma is very interesting since previous workers have shown that, in the adult, the amount of prolongation is directly related to the amount of decidual tissue induced. Apparently in the puberal rat a maximal deciduoma formation, even though only 60 per cent of that of the adult, is still capable of exerting the same degree of influence as the adult deciduoma in the prolongation of pseudopregnancy.

Conclusion

Deciduoma formation, although possible at the pseudopregnancy induced at the time of vaginal opening, did not attain the adult size until the animals had reached the sixth estrus cycle. The puberal animal was found to be susceptible to the effects of pretrauma starvation. The susceptibility was attributed to a loss of uterine sensitivity resulting from the stress of starvation.

The presence of deciduoma in the uteri of puberal rats caused a prolongation of the pseudopregnant period almost extending it to that of the normal gestation interval.

Microfilm $2.50; Xerox $4.40. 81 pages.

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Abstract published by special arrangement with The Ohio State University.

DETERMINATION OF THE TIME OF OVULATION IN THE RHESUS MONKEY BY THE SAMPLING OF VAGINAL MUELLERIAN DUCT DERIVATIVE

(L. C. Card No. Mic 59-6824)

Lloyd Bernhardt Erikson, Ph.D.
University of Illinois,
Chicago Professional Colleges, 1959

The specificity of the vaginal smear as a criterion of ovulation depends upon the sensitivity of the vaginal exfoliate material to circulating ovarian hormones. Ovulation occurs in relation to these hormone concentrations. Ovulation may be readily confirmed by laparotomy. Comparisons of daily smears taken during anovulatory and ovulatory cycles may be made.

Forty laparotomies were performed on a colony of 14 monkeys between the fall, 1956 and spring, 1958. Of the 125 cycles recorded within the first year of this study, 21 were demonstrated to be ovulatory.

Vaginal smears were taken from the cervical end of the vagina and ectocervix, the area of Muellerian duct derivate. The smears were stained with the Shorr differential stain after rapid fixation in alcohol. A comparison was made between the results obtained using the Shorr stain and the results obtained using the Papanicolaou stain.

The degree of cornification was assessed in percentile of cornified cells in the smear. The Hartman sedimentation index from the vaginal lavage was concurrently recorded.

In the 14 animals studied, 12 yielded daily smears intermenstrually that systematically contained a greater percentage of cornified cells than any of the daily smears of anovulatory cycles.

By castrating a monkey during menstrual cycle at a critical time, it was possible to demonstrate that the vaginal smear could be used to demonstrate the onset of the period of corpus luteum formation.

Replacement therapy upon two castrate animals made it possible to demonstrate that the vaginal mucosa proliferates under estrogen administration and that the vaginal smear is a more faithful index of this developmental process than is the sedimentation in the vaginal lavage.

Careful lavages made when uterine withdrawal bleeding was imminent revealed an increase in vaginal sloughing suggestive of a common catabolic action on both the uterine and vaginal mucosa.

Microfilm $2.50; Xerox $8.40. 181 pages.

THE EFFECT OF FIBRIN-STABILIZING FACTOR ON THE SUSCEPTIBILITY OF CLOTS TO FIBRINOLYSIS

(L. C. Card No. Mic 59-6707)

Sheldon Fred Gottlieb, Ph.D.
The University of Texas, 1959

Supervisors: M. Mason Guest, Ph.D.
D. R. Celander, Ph.D.

Although little or no emphasis in previously reported studies on the fibrinolytic enzyme system has been placed

upon the effect of possible variations in the fibrin substrate, fragments of evidence have been accumulating to indicate that the susceptibility of the clot to lysis may be influenced by the nature of the fibrin clot as well as the concentration of the activated enzyme. Recently, specific attention has been directed toward the role of calcium ions and a globulin, the fibrin-stabilizing factor, in altering the properties of fibrin so as to render it mechanically stronger and less soluble in solvents such as 5 M urea and 1% monochloracetic acid. Based on this information it was reasoned that since fibrin depositions function in the maintenance of hemostasis as well as forming the foundations upon which wound repair can proceed, both the strength and the stability of the clot, as modified by the fibrin-stabilizing factor in conjunction with calcium ions, would be important in determining its survival as a functional unit. Therefore an examination was undertaken to determine the effects of the fibrin-stabilizing factor on the propensity of fibrin to undergo proteolysis. It was also hoped that such a study would contribute to the basic understanding of the in vivo fibrinolytic process. The more pertinent observations from this study follow.

Freeze-thaw fibrinogen was shown to contain a potentially-active fibrin-stabilizing factor (FSF) activatable by cysteine. Heating the fibrinogen at 40° C for 1 hour or 37° C for 3 hours destroyed the potentially-active FSF. Calcium ions were replacable by strontium or manganous ions in the formation of monochloracetic acid (1%) insoluble clots. The insoluble clots formed in the presence of cysteine-activated FSF and calcium, strontium, or manganous ions were more resistant to fibrinolysis by the proteolytic enzymes, fibrinolysin and trypsin, than the soluble clots tested. However, inhibition of clot lysis was not obtained when magnesium was used in place of calcium, strontium, or manganese.

In experiments employing a purified bovine FSF preparation, insoluble clot formation occurred in the presence of calcium ions, but strontium and manganous ions were ineffective as replacements for calcium unless a reducing agent was added to the system. Furthermore purified bovine FSF directly inhibited fibrinolysis and evidence was obtained that a dual mechanism was involved in the total inhibition: 1. a direct inhibition of the proteolytic enzyme, not potentiated by calcium, and 2. a cation dependent change in the nature of the substrate resulting in clots which have a greater resistance to fibrinolysis than can be accounted for by the direct FSF inhibition.

The purified bovine anti-fibrinolysin preparation tested did not contain FSF activity and its antiproteolytic activity was not enhanced by calcium ions.

Although the rate of spontaneous lysis of clots prepared from citrated dog plasma was inhibited by the presence of either calcium, strontium, or manganous ions, the inhibition disappeared when the plasma was treated with p-chloromercuribenzoate, à sulfhydryl inhibitor. The p-chloromercuribenzoate also prevented the formation of monochoracetic acid-insoluble clots.

On the basis of the information obtained from these studies it appeared that an animal may have at its disposal another means of controlling the rate of lysis of thrombi. Thus, the nature of the in vivo clot may be determined by the conditions under which clot formation occurs and the susceptibility of these clots to proteolysis may be related to the function these clots subserve in the maintenance of homeostasis. Because of its dual function in inhibiting fibrinolysis, it is suggested that experiments be designed to test the effectiveness of preparations of purified fibrin-stabilizing factor in the clinical control of hyperplasminemia. Microfilm $2.50; Xerox $5.40. 108 pages.

THE EFFECTS OF CALCIUM, MAGNESIUM AND ETHER ON MINCED FROG MUSCLE

(L. C. Card No. Mic 59-4623)

James E. Griffin, Ph.D.
University of Pennsylvania, 1959

Supervisor: L. V. Heilbrunn

For many years physiologists have studied the role of cations in biologic systems. The present project was set up to determine what effects calcium, magnesium and ether have on the weight of minced frog muscle. Weight changes are regarded as being primarily due to loss or addition of water.

Method: The frog was pithed in such fashion that the hindlimbs went into strong extensor thrust. The skin was stripped off of one leg. All thigh muscles plus the gastrocnemius were cut from their attachments and in turn cut into chunks, each weighing several tenths of a gram. The cut up muscle was then placed into a previously prepared centrifuge tube. The same procedure was then followed for the opposite leg. Tissue from the right leg was always placed in the test solution while that from the left was placed in the control solution. The weights of these sample pairs were always the same to within 0.2g prior to exposure to solution.

The tissues were centrifuged at 1500 r.p.m., weighed to the nearest 0.0001 g and then exposed to varying concentrations of $CaCl_2$, $MgCl_2$ or 1% ether. Distilled water and 0.125M NaCl were used as controls. After a one hour exposure period the samples were recentrifuged and reweighed. The weight changes were converted into percentage weight change.

Results: Minced muscle exposed to $CaCl_2$ always showed weight loss (144 samples) relative to its control, except when the most dilute $CaCl_2$ (0.000625M) was used. The concentration at which the reaction seemed most effective was 0.003125M $CaCl_2$. Muscle exposed to $MgCl_2$ usually showed weight gain (144 samples) relative to its control. The concentration effectiveness was approximately the same for molarities on the order of 0.003125 and above. Muscle exposed to 1% ether usually showed weight gain, but only about half as great as that observed with $MgCl_2$. The results with all the test solutions were more clear cut when distilled water was the control solution. When NaCl was used as control there was greater fluctuation in the control weight change pattern.

The next step was to see if a mixture of ether plus calcium as a test solution would modify the weight change picture given on exposure to calcium alone. When the calcium concentration was low, 0.003125M or less, ether made the weight loss less severe, but if the calcium concentration was high (0.009375M) the alteration disappeared.

Conclusions: Calcium acts on this colloidal system in such fashion as to cause loss in weight. This reaction is more pronounced than that given by ether or magnesium.

Magnesium acts so as to cause gain in weight. Ether acts so as to cause gain in weight but not as great a gain as seen with magnesium. The method used seems a simpler and more realistic means of measuring colloidal changes brought about by calcium, magnesium and ether than the use of muscle homogenates or glycerinated fiber models. The results follow the same general pattern.

Microfilm $2.50; Xerox $3.00. 52 pages.

THE EFFECT OF VARIOUS HORMONES ON AUTOXIDATION OF LINOLEIC ACID IN THE PRESENCE AND ABSENCE OF ASCORBIC ACID IN VITRO

(L. C. Card No. Mic 59-5515)

Robert Maynard Grodner, Ph.D.
Louisiana State University, 1959

Supervisor: Professor B. Theodore Cole

Studies were conducted to determine the effect of selected hormones on the autoxidation of linoleic acid in the presence and absence of ascorbic acid in vitro. Oxygen consumption and ascorbic acid were also determined in the presence of insulin and estrogenic substance for further information.

The hormones tested were commercial preparations of the following: insulin, corticotropin (ACTH), cortisone, progesterone and estrogenic substance (equilin and equilenin).

Autoxidation of linoleic acid was determined by measurement of the peroxide value using the ferrothiocyanate colorimetric method. Four different treatments were used with reactants in phosphate buffer as follows:

1. Linoleic acid alone
2. Linoleic acid and hormone
3. Linoleic acid and ascorbic acid
4. Linoleic acid, ascorbic acid and hormone.

Measurements of peroxide formation were determined on two milliliter aliquots at zero, two and four hours respectively while samples were shaken at 37 ± 1° C in the presence of air. The oxygen consumption of linoleic acid with added insulin and estrogenic substance in the presence and absence of ascorbic acid was determined by the use of the Warburg apparatus at one half hour intervals over the four hour incubation period at 37 ± 1° C. Ascorbic acid measurements were determined on two milliliter aliquots containing ascorbic acid and linoleic acid in the presence and absence of insulin and estrogenic substance at the start and end of the four hour incubation period by the indophenolxylene extraction method. The results were analyzed for statistical significance and presented graphically and in tabular form.

It was determined that linoleic acid incubated in phosphate buffer at 37 ± 1° C in the presence of ascorbic acid with insulin, cortisone, ACTH, progesterone and estrogenic substance increased significantly the autoxidation of linoleic acid as measured by increased hydroperoxide formation at two and four hours.

However, linoleic acid incubated in phosphate buffer at 37 ± 1° C in the absence of ascorbic acid with cortisone and estrogenic substance decreased significantly the autoxidation of linoleic acid, while insulin, progesterone and ACTH increased significantly the autoxidation of linoleic acid as measured by hydroperoxide formation at two and four hours.

It was determined that in the presence of insulin and estrogenic substance the oxygen consumption was higher than in the absence of these hormones, regardless of the presence or absence of ascorbic acid, over the four hour incubation period.

It was determined that there was drastic reduction in the concentration of ascorbic acid at the end of four hours of incubation when ascorbic acid was incubated in the presence or absence of insulin and estrogenic substance with linoleic acid.

The results suggested that the hormones tested can exert a direct effect upon the autoxidation of linoleic acid, an essential fatty acid. The possible correlations of these findings with in vivo mechanism were discussed.

Microfilm $2.50; Xerox $5.80. 116 pages.

TOXICOLOGICAL STUDIES ON CERTAIN TRANQUILIZING DRUGS

(L. C. Card No. Mic 59-3752)

Raymond Frank Johnston, Ph.D.
University of Minnesota, 1959

The following project was designed to determine the toxicity of certain tranquilizing-type drugs with styramate serving as the pilot compound.

Styramate was given orally to thirty-six mature beagle dogs for periods of three and six months. The dogs were divided into four groups, one for control and three for different levels of styramate administration. The dogs were weighed at regular intervals and data were obtained from the following determinations: complete blood counts; blood chemistry; chemical and physical urinalysis; kidney function tests; liver function tests; electrocardiograms; addiction qualities; gross and microscopic pathological examinations; radioactive iodine uptake and thyroid iodine content.

There were no significant physiological changes in any of the dogs except those on the highest level of administration. Styramate given to dogs influenced the body weights of the dog in proportion to the amount given and the duration of the administration. Styramate administration at levels of 360 mg./kg body weight daily or less for periods of three and six months did not produce significant changes in the results of the hematological determinations. However, the dogs receiving 720 mg./kg daily exhibited indications of a hemolytic anemia. There were also severe alterations in the results of the liver function tests of those dogs receiving this high dosage. This group of dogs showed evidence of bromsulphalein dye retention, icterus, and bilirubinuria. Kidney function was not impaired by styramate administration. However, there was a decrease in the ability of the dogs to concentrate urine inversely proportional to the level of styramate administration. Styramate did not produce indications of a withdrawal syndrome or addiction following long or short term

administration, but there were evidences of tolerance and residual effects.

No significant pathological changes were found in any of the dogs except those receiving styramate at the rate of 720 mg./kg body weight daily. In this group gastroenteritis, enlarged fat-infiltrated livers, and atrophy of the germinal epithelium of the tubules of the testes were observed at necropsy. Styramate produced no consistent electrocardiographic changes. Radioactive iodine uptake varied with the level of administration of styramate as did the iodine content of the thyroid gland.

Styramate dosages of 360 mg./kg body weight daily or less were found to be non-toxic; dosages of 720 mg./kg body weight daily produced toxic symptoms in the majority of dogs. Very low levels of administration of styramate appeared to stimulate unusual weight gain, polyurea, and changes in thyroid activity.

Many findings in this experiment warrant further study.

Microfilm $2.55; Xerox $8.80. 193 pages.

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

FUNDAMENTAL CONCEPTS IN CONSIDERING HOME RULE FOR NEW ENGLAND TOWNS AND CITIES

(L. C. Card No. Mic 59-3449)

James Louis Blawie, Ph.D.
Boston University Graduate School, 1959

Please see abstract on page 2819.
Microfilm $7.65; Xerox $26.20. 603 pages.

PRIVATE LITIGATION UNDER FEDERAL ANTITRUST LAW: A STUDY OF THE JUDICIAL PROCESS.

(L. C. Card No. Mic 59-4423)

Winston Mills Fick, Ph.D.
The Claremont Graduate School, 1959

The federal antitrust statutes have contained, since enactment of the Sherman Act, provision for private civil litigation for treble damages against violators.

In recent years such cases have increased markedly in numbers and in success. Little discussion of this development has appeared in the scholarly literature, nor has there been appraisal of this litigation as part of antitrust policy or, more generally, of what it may suggest about the judicial process and the potentialities of that process in effectuating public policy on regulation of business.

The present interest of the subject is increased in that both antitrust and also regulation by administrative agency are undergoing some reconsideration and appraisal.

This study is intended to provide, first, an introduction to private antitrust litigation, and, second, some preliminary analysis of the judicial process as revealed in it. The latter leads to the question of the use of the courts in economic regulation generally. The study is limited to the trial-court stages; they are the most crucial for anti-trust, the ones in which the law as actually applied differs most from the law as generally stated, and the part of the judicial process least known to political science and legal scholarship. The study is based in part on some selected recent district court proceedings. The methods used are principally those customary in political science and legal scholarship. However, the study attempts to penetrate somewhat into actual organization, process, and behavior in the trial-court stages; for this some of the concepts of modern studies of political behavior are shown to be very valuable.

The study presents a general view of private antitrust and its relations to current antitrust issues. It shows, by legal analysis of legislative drafts and debates, that the private remedy was designed as a powerful and usable weapon against the evils at which the Sherman Act was directed. It analyzes the nature of the law and policy of private antitrust in detail, and reviews the course of typical cases.

Several conclusions emerge. Private civil litigation under the statutes is a workable device of government, capable of playing a substantial minor part in enforcement of antitrust policy. It seems a plausible hypothesis that the judicial process can feasibly be more used in regulatory policy generally. The truth of the view, of Jerome Frank, Karl Llewellyn, and others, that process and "effective" law in the trial courts have a marked character of their own is again demonstrated. Judicial process in the federal trial courts, built on the unfocussed naturalism implicit in the Federal Rules, and on regulatory statutes broadly declaratory of policy, is a new, vital, and useful tool available for public control of economic activity.

Microfilm $4.60; Xerox $15.40. 359 pages.

DEPORTATION OF ALIENS: A STUDY IN CIVIL LIBERTIES.

(L. C. Card No. Mic 59-6097)

Robert John Frye, Ph.D.
The University of Florida, 1959

The problem of deportation of aliens is the problem of reconciliation of two competing concepts. One concept is based on the idea that the power to deport arises from the same source as the power to exclude aliens: namely, the inherent authority of a sovereign nation to protect itself from the presence of undesirable aliens. This principle was expounded in 1892 in Fong Yue Ting v. United States, the landmark decision of the Supreme Court. A corollary of this concept is the principle that deportation is a civil proceeding. Thus the constitutional principles, guarantees, and remedies applicable to criminal proceedings do not prevail. The second concept is based on the idea that the alien enjoys certain residual rights under the Constitution which may not be denied him without affording him the same guarantees as those available to the citizen.

While originally viewed as merely an instrument of the exclusion power of the national government, the legal aspects of deportation have shown a tendency to develop independently of the exclusion power. As a result of concern over the presence of the alien pauper, criminal, subversive or the morally unfit, deportation developed as a policy in its own right. An alien, originally eligible for admission, could be deported for conduct or circumstances arising subsequent to his legal admission. This brought about significant modification in existing legislation relative to the number of grounds for deportation of aliens.

The McCarran-Walter Act is the culmination of this historical development.

American deportation policy may thus be characterized as essentially legislative in nature. Congressional judgment has held sway over the administration of deportation, with the result that very little discretion lies in the executive branch as to the grounds for which an alien shall be deported. Congress has also restricted executive authority to grant discretionary relief -- suspension of deportation and voluntary departure -- to the alien. The role of the courts in deportation has been a decidedly passive one, and they have shown little inclination to question the judgment of the political branches.

The net effect of such a policy is to render the alien excessively vulnerable to the workings of the deportation process. It is here that the problem of civil liberties lies. It is especially apparent when Congress has made possible in most cases deportation at any time after entry, despite the length of residence of the alien in this country. In the final analysis alteration of American deportation policy can come about only through a modification of Congressional attitudes toward deportation, and through a more rational balance as to the respective authority of the three branches of government in the deportation process.

Microfilm $7.00; Xerox $24.20. 552 pages.

PARTIES, PARTISANSHIP, AND LOCAL POLITICS IN TWO OREGON COMMUNITIES.

(L. C. Card No. Mic 59-6433)

Daniel Goldrich, Ph.D.
The University of North Carolina, 1959

Supervisor: Donald R. Matthews

This study is concerned with the relationships between parties, partisanship, and community power structures. The research sites were two Oregon communities of about 2,000 and 16,000 population. Principal data sources were random sample surveys of the residents, leadership studies, random sample surveys of business and professional men, case studies of selected aspects of local politics, observation of party activities, and interviews with key informants. The major tool of analysis was a Community Political Participation Scale, used to assign the random sample respondents to one of three power strata: activists, participants, and inactives.

The two local political systems were analyzed in terms of the following factors: the scope of the political system, the degree of politicization of the residents, the major political groups, the distribution of power, and the relationship of the local political system to the social, economic, and other political systems. The relationships between parties, partisanship, and the local political systems were also examined in terms of these factors. Changes over time in the relationships were investigated, particularly with regard to the mobility of Democrats and Republicans in the power structure.

The major findings are as follows. Most of the proposals for an expanded scope of government in the two communities were made by Democrats. Opposition stemmed mainly from Republicans. The positions adopted by these local adversaries paralleled those of the two parties in national politics, where Democrats tend to favor adding to the tasks of government, and Republicans tend to favor limitations.

Where the degree of politicization was low, proponents of change encountered difficulty in mobilizing support for their policies. Where the proponents of change were affiliated with a party that was weak in the community, they encountered added difficulty. When the formerly weak party adopted a vigorously competitive stance, the effect locally was to raise the level of politicization. This facilitated the organization of support for proposals challenging the local policy status quo. One indirect effect of increased partisanship was thus to modify the scope of local government.

The composition of the community leadership affected the parties and was affected by partisanship. Where the top leaders were all Republicans, Democrats throughout the community were repressed politically. Where the leaders included top local government officials of Democratic affiliation, Democratic residents were active in politics. Where the officials were oriented toward expansion of the scope of local government, the high level of Democratic participation helped effectuate basic policy changes.

The distribution of party identifications tended to remain constant in the communities, regardless of the partisanship of the dominant leaders, because Democrats tended to identify with Democratic top leaders, and vice versa for Republicans. If there were no fellow partisans among the top leaders, party identifiers tended to be perceptually distant from the power superstructure.

Democrats failed to participate as actively as Republicans in the civic associations in both communities. In one of the latter, the associational network consequently operated as a natural Republican party organization. Local policies favored by Republicans and a local environment advantageous to the party were promoted. In the other community, the role of the civic associations was considerably diminished, because Democrats were strongly represented in the major political groups and because their leaders had developed an informal political organization of labor union representatives and party workers. It was also found that a politically heterogeneous civic association environment moderated the partisanship of both Republicans and Democrats, although the effect was stronger on the latter.

Partisanship also had a significant impact on the relationships between the local political system and the social structure, the process of urbanization, and the process of industrialization.

Microfilm $3.80; Xerox $13.00. 296 pages.

PARENT AND CHILD IN THE COURTS OF THE UNITED STATES

(L. C. Card No. Mic 59-4634)

Norma P. Jacob, Ph.D.
University of Pennsylvania, 1959

Supervisor: Henry J. Abraham

A study of ways in which the parent-child relationship is modified, circumscribed and sometimes even broken off by action of the state through the courts. The growth and development of the doctrine of parens patriae is traced

and contrasted with the picture of absolute parental rights prevailing in the ancient world.

The largest part of the study is devoted to court decisions of the past hundred and fifty years in the United States, with some reference to British decisions which help to illustrate some of the concepts involved. These concepts include child abandonment and neglect, parental fitness or unfitness, and the right or duty of the state to intervene where parents have failed. Limits set by court action to intervention by public bodies are especially considered, with a view to determining how far there does exist a genuine consensus as to what the state may do when it sees a need to protect a child's interests against its own parents. The conclusion is reached that while the state does at the present time have almost unlimited power to intervene, in its capacity as parens patriae, judicial practice is to safeguard the parent's rights against the state wherever possible. In particular, the courts have shown determination to uphold the requirements of due process in permitting any kind of encroachment upon the family relationship.

It is suggested that in the light of contemporary social and psychiatric knowledge, decisions are sometimes made in such a way as to safeguard a parent's rights at the expense of the right of the child to a healthy, secure and stable family life. This is particularly so in the case of the safeguards usually placed about the adoption process, where a parent's right to change his or her mind about the future of the child may sometimes be exercised in such a way that the child is subjected to a succession of changes and gets little opportunity to grow into a well-adjusted member of society.

The state's right to require of parents that they provide their children with medical care and education of acceptable quality is reviewed at some length on a basis of recent judicial decisions. This calls for a review of First Amendment rights as applied to the states through the Fourteenth Amendment, since for the most part parental resistance to providing the type of care the community deems necessary is based on beliefs about religious freedom.

On several important questions of principle, judicial decisions are found in conflict with each other, with resultant uncertainty reflecting adversely upon family life and social institutions generally.

Taken as a whole, the dissertation is a study of individual rights against the sovereign and the balance which has been achieved between the two, with indications of directions in which this balance may be modified for the future good of the society of which parents and children form a part. Microfilm $2.50; Xerox $8.80. 192 pages.

THE FLAG SALUTE LITIGATION

(L. C. Card No. Mic 59-5797)

David Roger Manwaring, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor David Fellman

On June 3, 1940, in Minersville School District v. Gobitis, 310 U.S. 586, the Supreme Court held by a vote of eight-to-one that public school children could be required, on pain of expulsion, to salute and pledge allegiance to the United States flag notwithstanding their sincere religious objections to the performance of such a salute. Three years later, in West Virginia State Board of Education v. Barnette, 319 U.S. 624, the Court overruled its previous decision, holding that no civilian citizen could constitutionally be required to salute a flag or participate in a pledge of allegiance, however worded.

The two flag salute cases are just the twin climaxes of a continuing controversy dating back at least to 1918, and with roots extending back into the nineteenth century. Since 1935, the issue had been the subject of constant litigation brought by or against members of the sect called Jehovah's Witnesses, who considered the flag salute ceremony a sort of idolatry forbidden by the Bible.

This is a frankly institutional study. While special attention is devoted to the two principal cases, the object is to describe as fully as possible the flag salute controversy as a whole. Particular subjects of inquiry are:

(1) the intergroup maneuvering underlying the litigation;

(2) the development and transformation in this litigation of the legal principles governing freedom of religion and of conscience, with particular reference to the rise and fall of what is called the "secular regulation" rule--i.e., the doctrine that one's conceptions of religious duty cannot excuse one from obedience to general laws dealing with secular matters; and

(3) the complex relationship between the Supreme Court and its "public," with specific reference to (a) the various forms of public reaction to the two principal decisions, and (b) possible explanations for the Court's reversal of field.

Part One, "Background," comprises chapters I-IV, dealing respectively with the background of the compulsory flag salute, the history and nature of the sect Jehovah's Witnesses, the body of legal precedent covering the legal issues involved in the flag salute litigation, and flag salute litigation preceding the Gobitis case.

Part Two, "Minersville School District v. Gobitis," comprising chapters V-X, traces the history of the Gobitis litigation from the local beginning of the dispute through the lower federal courts to the Supreme Court decision.

Part Three, "Interim," comprises chapters XI-XIV, dealing respectively with press response to the Gobitis decision, the wave of anti-Witness persecution generally blamed on that decision, the treatment of the Gobitis precedent by the state courts in dealing with related issues, and the license tax cases (Jones v. Opelike, 316 U.S.584--1942), in which three Justices who had voted for the Gobitis decision publicly changed their minds.

Part Four, "West Virginia State Board of Education v. Barnette," comprising chapters XV-XVIII, traces the Barnette litigation from its local beginning through the lower federal court proceedings to the Supreme Court decision overruling the Gobitis decision; a final chapter surveys the public reception to the Barnette decision, using the categories set up by chapters XI-XIII.

Part Five, "In Conclusion," contains some concluding remarks by the author.

The author has relied heavily on federal and state court reports, as well as the American Civil Liberties Union Archives (microfilm, New York Public Library). In the beginning of 1957, he traveled through Pennsylvania, West Virginia and New York interviewing most of the

principal parties. He received special help from the Civil Rights Section of the Department of Justice in compiling a statistical survey of anti-Witness persecution during the period 1940-43.

Microfilm $9.70; Xerox $34.60. 765 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE INFLUENCE OF THE IRISH-AMERICANS UPON THE FOREIGN POLICY OF THE UNITED STATES: 1865-1872.

(L. C. Card No. Mic 59-6189)

James Martin Mahoney, Ph.D.
Clark University, 1959

Supervisor: Sherman S. Hayden

The purpose of this thesis is to examine the influence of the Irish-Americans upon the foreign policy of the United States in the period 1865-1872. While this work deals with the Irish-Americans in general, it concentrates upon the Fenian Brotherhood. This revolutionary organization as the most important body among the Irish-Americans represented their greatest impact upon American foreign policy. The actions of the Fenians created two difficult problems for the American government. First, the Fenian raids on Canada raised the awkward issue of how to enforce the neutrality laws of the United States in opposition to a popular cause and how to deal with the Fenian leaders who had violated these laws. Second, the revolutionary actions of the Fenians in the United Kingdom raised the important question of just what rights Irish-born American citizens possessed in the face of a claim that they were still British citizens in the eyes of British law.

Investigation revealed that Irish-American pressure forced the United States to demand a settlement of the naturalization controversy. The arrest of numerous Fenians in Ireland precipitated the naturalization controversy, and Irish-American opinion grew so heated on the issue that Secretary of State Seward felt a solution of it to be essential. The Fenian raids on Canada intensified Canadian-American distrust and increased the general Anglo-American tension still so prominent in the Civil War's aftermath. The American government's attitude toward Fenianism, while in some respects vacillating, was by no means hostile. In fact, it is clear that Fenians, supposedly having the support of a large bloc of voters, operated with virtual immunity from Washington's interference. Indeed, misled as they were by the constant verbal support accorded their cause by the American politicians, they even expected the American government to aid them in liberating Ireland. The British authorities, obviously, hoped by coming to an agreement on the naturalization question to kill American Fenianism and soften American distrust of Great Britain. While the connection of Fenianism with the Treaty of Washington was less important than its connection with the naturalization controversy, the question of damages for the Fenian attacks on Canada, for a time, actually threatened a delay in Canadian ratification of that Treaty.

Of the sources consulted in this work the diplomatic correspondence of the period, especially that of Seward, was useful in dealing with the problem of "dual citizenship" and the British reluctance to recognize the validity of the American naturalizations of British-born subjects. In addition, such standard sources as personal correspondence, memoirs, and biographies were consulted when pertinent. The newspapers of the period, particularly The New York Times which was very hostile to Fenianism, and the New York Herald which was especially favorable to the revolutionary organization were found to contain much useful material on Fenianism and its impact.

Microfilm $5.50; Xerox $19.40. 431 pages.

THE FOREIGN POLICY OF LEBANON

(L. C. Card No. Mic 59-6318)

Ghaleb S. Shaheen, Ph.D.
Syracuse University, 1959

Supervisor: W. W. Kulski

As a result of the various religious denominations in Lebanon, confessionalism has been regarded as the most durable of the country's political institutions. While this sectarianism is blamed by many for most of Lebanon's ills, there are some who believe that this structure is the raison d'etre of Lebanon.

To a limited degree and with great reservation, the differences in ideas correspond to the differences of religious confession. In general terms there are two major groupings in Lebanon which differ in their orientation and outlook. The first group looks towards the West and feels its kinship with Western thought, culture and religion, therefore bearing towards it a friendly attitude. This group thinks of the integrity and sovereignty of Lebanon as an end in itself, and accordingly does not believe in any form of Arab union, whether unity or federation.

The other major group considers itself as a natural part of the Arab world in every respect: culturally, spiritually, and religiously. To them, the Lebanese are simply a branch of the Arab people and their destiny is indistinguishable from that of the Arabs as a whole. The first group is Christian in religion, mainly of the Maronite and other Uniate churches. The second is predominantly but not exclusively Muslim.

The preservation of Lebanon's independence and sovereignty has been the main concern and the first and most important pillar of the country's official foreign policy. Another fundamental pillar is the principle of its membership in the Arab family. As an integral part of the Arab world, Lebanon favors full and close cooperation with the other Arab states on the basis of the Pact of the Arab League, and it stands with the Arab countries in regard to every Arab problem. However, at the moment, it seems that the official attitude of Lebanon is not to take part in any Arab unification, federation or even confederation.

By the character of its people and by the necessities of its location and small size, Lebanon tries to keep friendly relations with all foreign countries. However, the country's

foreign policy has been based on the principle of cooperation with her Western friends, notably the United States.

In spite of the fact that Lebanon has been considered as one of the most anti-neutralist among the Arab countries, it refrained from committing itself to the West through the Baghdad Pact, largely due to the split among the Arab countries which the Pact initiated. Hence the Lebanese government offered its blessings but not its participation. However, two years later, the Lebanese government aligned itself officially with the United States by endorsing the Eisenhower Doctrine.

Lebanon stands solidly with the Arab countries in any conflict between the Arab world and the West involving the legitimate aspirations of the Arabs. As regards the conflict between the West and the East, Lebanon ranges itself on the side of the West. The role of Lebanon in international politics, limited as it is, definitely is out of proportion with its size and military might.

Microfilm $4.55; Xerox $15.40. 356 pages.

UNITED NATIONS PARTICIPATION IN KOREAN AFFAIRS: 1945-1954.

(L. C. Card No. Mic 59-3642)

Young Kyo Yoon, Ph.D.
The American University, 1959

Statement of the Problem

Since the end of the second World War the position of Korea has been tremendously important in world affairs. In particular the actions of United Nations in respect to the Korean conflict have been of special importance. It is the purpose of this study (1) to review the achievement of the United Nations in the establishment and recognition of the Republic of Korea and (2) to study the United Nations collective activities against Communist aggression in the Korean war.

Major Problem of Research Involved

What was the significance of the activities of the United Nations in Korea from the establishment of the Republic of Korea to the end of the Korean war?

What were the objectives of the United Nations participation in the Korean conflict?

Data and Method used in Research

Primary and secondary sources are English and Korean documents, publications, books and newspapers. The approach to this research is both to find facts and to analyze.

Conclusion

The writer points out what appeared to him the most significant conclusions brought into view by the entire study.

The establishment of the Republic of Korea's free and independent democratic government was one of the greatest accomplishments of the United Nations. At every session of the United Nations since the fall of 1947, the Korean question has been an important part of the United Nations' business.

In every meeting and at every conference to settle the problem of the peaceful unification of Korea, Russia has always rejected the United Nations proposals. Russia and its satellites have shown their intention of taking over all of Korea. North Korean forces were trained and equipped by Russia and Moscow's direct order caused the Korean war.

United Nations efforts succeeded in stopping Communist aggression in Korea and prevented the Communists from gaining their prime objectives. This marks the first time that forces assembled by the United Nations have achieved collective action.

The Korean experience has special value for the light which it throws on the future of United Nations collective action against aggression.

The Korean experience has shown that collective measures can be taken under the authority of the United Nations and that the aggressor can be made to pay such a high price as to induce him to end hostilities on terms acceptable to the United Nations. However, the physical repelling of aggressor forces may be much easier than ending hostilities on acceptable terms and making a satisfactory settlement. The transition from collective pressure to conditions of peace and security is never easy.

The United Nations action did not succeed in attaining a unified, free, and democratic Korea, but the armistice agreement provided that higher political negotiations would be held. Since the failure of the Geneva Conference, no one can say when an agreement upon a united Korea can be reached. It is almost impossible to obtain such a peaceful settlement unless the Communists change their aggressive policy.

The United Nations objectives in Korea are threefold. Its military objective was to repel the Communist aggression and secure the peace; its economic objective is rehabilitation and reconstruction; its political objective is reunification of Korea. Though a cease-fire has been attained, reunification still remains to be achieved.

Microfilm $3.50; Xerox $12.00. 271 pages.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

A STUDY OF THE FEDERAL-AID HIGHWAY PROGRAM WITH SPECIAL EMPHASIS ON ITS MAJOR BUDGETARY AND PLANNING ASPECTS

(L. C. Card No. Mic 59-3641)

Walter Kurylo, Ph.D.
The American University, 1959

This dissertation covers two problem areas of the Federal-aid highway program. One is the major budgetary aspects of this program and the other is its major planning aspects.

The document presents information obtained from numerous official sources, from interviews with Federal officials and others, and from other media having pertinent information. It involved use of the historical, analytical, comparative, legal and statistical methods of research.

The early Federal and State interest in highway development, from the inception of the Nation through 1915, is

reviewed. The constitutional bases for the Federal-aid highway program are identified, and key Federal statutes are cited. Early constitutional obstacles to State cooperation are listed, and the measures taken to overcome those obstacles are reported.

The evolution of Federal-aid highway program budgeting from "budgeting by appropriations" to "budgeting by contract authorizations" is explained and compared with budgetary concepts applicable to other Federal programs. The effect of budgeting by contract authorization is shown for this type of program, which involves cooperation of different levels of government having different fiscal years.

The extent to which States link revenues from highway-user sources is identified. The purpose of the Highway Trust Fund at Federal level is explained.

The concept of Federal-aid highway system development as a major planning tool is identified. Explanation is given of the means by which national defense highway requirements, as determined by the Nation's responsible military officials, have become an integral part of Federal-aid highway system development.

Under the statutes applicable to the Federal-aid highway program, budgeting by contract authorization results in having one Congress, which enacts legislative authorizations to continue this program, commit a future Congress, or future Congresses, to appropriate funds to pay obligations as they become due. Certain problem areas arising in this program require increased public attention.

Microfilm $4.90; Xerox $16.40. 382 pages.

THE POLITICS OF RIVER BASIN APPROPRIATIONS: A CASE STUDY OF THE ROANOKE RIVER BASIN.

(L. C. Card No. Mic 59-6452)

Earle Wallace, Ph.D.
The University of North Carolina, 1959

Supervisor: Frederic N. Cleaveland

In the development of any river basin quarrels over the allocation of costs and benefits between affected groups are certain to materialize and to become the center of a political process which demands examination and discussion of values and goals, and of methods and techniques. Given Congress' firm control over civil functions, the Congressional state is clearly the center of this political process.

This study is focused upon a description and analysis of the political process involved in the development of the Roanoke River basin. In some respects, the development of this basin was commonplace, even routine. In other important respects, it was unique, as the combination of issues and interests are unique within any river basin. In the Roanoke basin the struggle to adjust conflicting interests was necessarily concentrated almost entirely within the annual appropriations process. This aspect of the study is significant because surprisingly little attention has been devoted to analyzing the role of the appropriations process in basin development.

The method used is descriptive and analytical with analysis proceeding on a pluralistic view of politics and the political process. Data for the study were obtained primarily from the written record, with interviews used to supplement this record.

Specifically, the study inquires into the major sources of influences brought to bear in shaping and modifying the decisions of the House and Senate Committees and of Congress itself in its annual appropriation of funds for the development program. The study is undertaken within a framework of the historical evolution of Congressional water policy, the characteristics of basin politics, and the motivation for and the techniques of continued control of policy by Congress. The conclusions are drawn within the context of the much criticized practice of authorizations and appropriations for basin programs by the use of omnibus bills which reflect the localized interests of both Congressmen and constituents.

The case study reveals the following aspects of the politics of securing appropriations for the Roanoke basin as the most significant: (1) the impact of crisis on the problem of securing appropriations; (2) the role of the appropriations committees in the arbitration of the group struggle over development; (3) the position and influence of the Corps of Engineers in the appropriations process; (4) the struggle of private groups for support to strengthen representation before Congress; (5) the significance of the lack of interstate conflict in program planning.

Typically, the major impetus for development of the Roanoke basin came from crisis demands for flood protection. This is characteristic of such programs, as the omnibus system of authorizing projects and making appropriations for project construction by Congress is geared to crisis demands. By having a "shelf" of authorized projects located in all parts of the nation, Congress can quickly satisfy constituent demands by the simple expedient of appropriating funds. This case study is another illustration of the well known Congressional interest in keeping the civil functions program at a high level of activity; this vested interest also places the supporters of development in a favored position while making the task of the opposition a formidable one.

Finally, the study demonstrates that despite increasing criticisms, as long as the demands of such groups as those involved in the Roanoke basin can best be satisfied through authorizations and appropriations of money on a localized basis, Congress is not going to change its procedures. It is not likely to abandon a system which enables it to satisfy constituent demands quickly while at the same time securing federal money for districts and states. From this context of varied local interests striving for a solution to their own local problems, a national water resources policy is not likely to develop.

Microfilm $6.20; Xerox $21.60. 488 pages.

PSYCHOLOGY, GENERAL

DELAYED RESPONSE PERFORMANCE AT THREE YEARS OF AGE AMONG CHILDREN WITH ANOXIC AND NON-ANOXIC EXPERIENCES AT BIRTH

(L. C. Card No. Mic 59-5505)

Iris Elizabeth Amos, Ph.D.
Louisiana State University, 1959

Supervisor: Professor T. W. Richards

The present study was designed to compare performance at three years of age of children who had delayed respiration and possible anoxic experiences at birth with that of children whose birth histories were ostensibly normal. Success on the delayed response and I.Q. (Stanford-Binet, Form L) were the criterion measures. The delayed response apparatus employed was a five choice-cup, partitioned, portable box. Candy could be placed in a randomly assigned cup, then all cups and the box covered during the delay interval.

On the basis of a pilot study, 1', 2', 3', 4', 5' and 10' intervals were used, each presented to each subject in random order, with Stanford-Binet items as the interpolated activity.

In all, nineteen three year olds with histories of artificially induced breathing and, in some cases, cyanosis, completed the experimental procedure. Twenty controls were obtained whose birth records showed normal breathing and reported them to be in "good condition."

Chi-square comparisons were made among the several experimental variables.

Results:

1. The two groups differed with respect to successful performance at the longest (10 minute) delay interval ($p = .05$), the controls being superior to the anoxics.
2. For the anoxemic youngsters, length of delay related significantly with successful performance (10' performance inferior to 1', 2', and 3', 5' and 4' performance each inferior to 1', all at .01). Among the control group, frequency of success did not differ from interval to interval.
3. Position of the correct choice cup did not relate to success of performance in either group.
4. Trial sequence did not relate to performance in the anoxic group, but related significantly for the controls, the latter showing a decrease in the number of successes during their last three, as opposed to their first three, trials ($p = .01$).
5. The two groups differed significantly with respect to mean I.Q. (t sig. at .01). In the anoxic group, I.Q. values related significantly with performance at the three longer delay intervals (.01) and showed a significant correlation with the number of successful intervals (rho = .69). No I.Q. performance relationships were demonstrated among the controls.

Microfilm $2.50; Xerox $3.00. 43 pages.

AN EVALUATION OF SEASONAL EMPLOYMENT AT A LARGE DEPARTMENT STORE

(L. C. Card No. Mic 59-6618)

Carole Boehm Bare, Ph.D.
The Ohio State University, 1954

The dissertation examined the relationship between such personal data variables as age, sex, number and kinds of previous jobs, time spent on previous jobs, recommendations, distance from place of work, marital status, and dependents and the following criteria: turnover, selection, production index, absences, red apple letters, merit raises, and seasonal selection.

In Analysis I the intercorrelations of the variables and the turnover criterion were factor-analyzed. A multiple correlation coefficient was obtained by the method of test selection. Of the nine variables, only one, age, predicts the turnover criterion (multiple r = 38). Five factors were isolated. One of these dimensions outlined patterns of characteristics which predict the turnover criterion.

In Analysis II the bases for the selection of permanent employees from the temporary seasonal group was examined. The intercorrelations and the test selection showed that good recommendations, the presence of dependents, marital status, previous sales experience, number of previous jobs, and the closeness of the place of work are considered good predictors for future success by the employers. None of these variables had shown validity for the turnover criterion.

In Analysis III, therefore, it was attempted to ascertain the relationship of these variables with other criteria. Both seasonally and nonseasonally hired employees were included in this sample. The following criteria were used in this analysis: production index, absences, red apple letters, merit raises, ratings on production, sales performance, stock care, knowledge of merchandise, customer relations, mental alertness, aggressiveness, dependability, cooperation, adaptability, and promotability.

The variables which the employers used as bases for selection did not show any predictive value for the objective criteria; two variables show significant correlations with the rating criteria; two show the opposite relationship. Alternative explanations are attempted for reasons why the employer's attitudes which govern the selection are opposed to those found present in the salary review ratings.

Eleven factors were isolated through the factor analysis. They were identified as follows:

1. General Reputation or Bias

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

2. Seasonal Selection
3. Peer Group Orientation
4. Reliability
5. Gender Discrimination
6. Executive Material
7. Compensation
8. Good Housekeeping
9. Long Service Employee
10. Sales Experience
11. Public Relations

It was established that there was overlap among the rating criteria (Factor I). The test selections for the production index criterion, the production rating criterion, and the promotability rating criterion showed the following results: Only the promotability rating criterion can be predicted by the weighted combination of the following personal data variables: The members of the male sex, who are younger, who live farther away from their place of work, and who have dependents are rated promotable.

The major result of Analysis III is the evaluation of seasonal selections. The seasonally hired employees tended to have lower production indices and ratings (Factor II), tended to be the poor housekeepers (Factor VIII), were rated low on dependability, cooperation, and the triad of rating scale traits which can be interpreted to represent some sort of general intelligence. No relationship between their seasonal selection and the promotability rating could be established.

The following suggestions for further research and modification in policy on the basis of this study were made:

1. The testing of new application blank items which have promise of validity such as an indebtedness record or personality items
2. The testing of a shortened sales review rating form, containing only six instead of the eleven traits. The following six areas are suggested on the basis of the factor pattern:
   a. General Intelligence
   b. Peer Group Orientation
   c. Good Housekeeping
   d. Customer Orientation
   e. Knowledge of Merchandise
   f. Promotability
3. The investigation of the costliness and the possible savings which may accompany a re-examination of the policy of seasonal employment
4. A re-examination of the recommendations record keeping
5. A re-examination of the red apple letter policy
6. A re-examination of the understanding which the supervisors have of the promotability concept and of the rating purposes in general.

Microfilm $2.50; Xerox $3.60. 61 pages.

Abstract published by special arrangement with The Ohio State University.

BIAS AS RELATED TO RATER CONTACTS

(L. C. Card No. Mic 59-6619)

Roderick Hughes Bare, Ph.D.
The Ohio State University, 1954

The purpose of the dissertation was to investigate the influence of the number of relevant rater contacts on rating accuracy. In addition, it was hoped that certain findings would bear indirectly on a second problem, rating accuracy as a function of easy to observe versus hard to observe behaviors.

Two theorems, taken from a theory of rating developed by Wherry were tested. These theorems are presented below:

> Theorem (1): Raters will vary in the accuracy of ratings given in direct proportion to the number of previous relevant contacts with the ratee.
>
> Corollary: The longer the rater knows the ratee on the job, the greater the probability that the ratings will be accurate.
>
> Theorem (2). Rating scale items which refer to easily observed behavior categories will result in more accurate ratings than will those which refer to hard to observe behaviors.

The procedures consisted of administering a student opinion rating form to two sections of an introductory psychology course. Four successive administrations of this same rating form were made, each being separated by a period of approximately three weeks. The initial administration occurred during the first week of classes, while the fourth was done during the final week. Each administration was analyzed by intercorrelating the twenty-five items of the rating form and factor analyzing the resulting matrix. Where possible, mid-term grades were also added to the matrices. The final step consisted of comparing the factor patterns across the four administrations in order to determine the nature of the changes resulting from an increased number of relevant rater contacts.

The results indicated that four major differences in the factor patterns have occurred across the four rating periods. (1) There is a slight tendency for the number of factors to increase as the number of relevant rater contacts increases. (2) Factor patterns show a strong tendency to become stable in direct proportion to the number of relevant rater contacts. (3) Increasing the number of relevant rater contacts may serve either to divide single factors into independent pieces, or to combine separate factors into a single dimension. (4) The greater the number of relevant rater contacts, the greater the tendency to relate hard to observe rating categories to easily observed behaviors in a meaningful way.

It was concluded that three of the major changes in the factor pattern (1, 2, and 3) are in direct support of theorem (1) and its corollary. The fourth change bears more directly on the content of theorem (2), and is also in support of it. Thus, greater rating accuracy (differentiation) does occur in proportion to the number of relevant rater contacts. In addition, greater rating accuracy will occur in connection with hard to observe rating categories as the number of relevant rater contacts increases.

A brief reference was also made to the content of the obtained factors, with particular emphasis being placed on

the general bias or halo dimension which appears in each of the analyses. Further stress was placed on the fact that all of the factors represent descriptions of the instructor which may or may not be desirable. Desirability can be ascertained only by relating these dimensions to an independent standard of performance.

In the section dealing with recommendations for future research, the need for an independent criterion of rater accuracy was pointed out, along with a suggestion that quantification of the rating components was also needed.

Microfilm $2.50; Xerox $3.80. 70 pages.

Abstract published by special arrangement with The Ohio State University.

THE DEVELOPMENT AND VALIDATION OF INSTRUMENTS FOR SELECTING FARM OPERATORS FOR FARM MANAGEMENT SERVICES

(L. C. Card No. Mic 59-6469)

Robert Eugene Blanchard, Ph.D.
Purdue University, 1959

Major Professor: E. J. McCormick

A preliminary investigation of the relationship between the human factor and relative success in a farming endeavor through the utilization of various prediction instruments.

The purpose of the study was to gain some insights as to the personal factors associated with relative success in agriculture, and to develop predictors which would aid professional farm management services in the selection of tenant farm operators. The general methodology employed was that which has been successfully utilized in the industrial situation for some time.

Biographical information was collected from 453 tenant farm operators and from 436 tenant farm wives, who were leasing farm land from eight professional farm management services in Indiana and bordering states. These samples were randomly assigned to experimental and cross-validation groups.

Criterion data were obtained by having 34 professional farm managers rate their respective tenant farm operators.

Analysis of the Tenant Farmer Questionnaire revealed a predictive validity of .25 on the cross-validation group. Upon further refinement of the biographical data items employed, the validity of .25 was considered an underestimate of the questionnaire's actual predictive ability in the population.

Analysis of the 436 Tenant Wife Questionnaires did not produce a final instrument with adequate predictive validity for utilization as a selection instrument.

A dual analysis of the Tenant Farmer Questionnaire and the Tenant Wife Questionnaire was performed by analyzing all possible pairs of biographical relationships which dealt with possession or non-possession of a particular characteristic. This analysis resulted in the construction of an instrument with a predictive validity of .26 on the cross-validation group. Upon further refinement, the obtained validity coefficient was considered to be an underestimate of the actual predictive ability of the Tenant-Wife Team Questionnaire. Interpretations were made of pertinent biographical relationships between successful tenant-wife teams.

A Free-Response Questionnaire was completed by 432 tenant farm operators wherein they were requested to list three reasons why they chose farming as a career, three farm tasks they liked most, and three farm tasks they disliked most. Completion of a content and category analysis revealed three response categories which significantly differentiated between subjects of differing levels of performance.

A battery of eight personnel tests was administered to a sample of 197 tenant farm operators with farm businesses in the State of Indiana. Correlation of the resultant test scores with the criterion scores revealed one significantly correlated test, that being the Kuder Occupational Form D using the Farmer Key.

An analysis was carried out to construct a Tailor-Made Key for the Kuder Occupational for tenant farm operators. This analysis produced a scoring key which correlated .34 with the criterion in the cross-validation group. This key was further refined, and the previous validity estimate of .34 was considered to be a lower bound estimate of the instrument's predictive ability in the population.

The Tenant Farmer Questionnaire and the Tenant-Wife Team Questionnaire were combined in a multiple regression equation. The resultant shrunken multiple correlation was .338. A multiple regression equation was also computed for the Tenant Farmer Questionnaire and the Tailor-Made Key for the Kuder Occupational Form D. The shrunken multiple correlation obtained in this instance was .425.

It was concluded that the Tenant Farmer Questionnaire, Tenant-Wife Team Questionnaire, Farmer Key for the Kuder Occupational, and the Tailor-Made Key for the Kuder Occupational showed some promise in predicting probable levels of performance in tenant farm operator selection.

Microfilm $3.50; Xerox $11.80. 269 pages.

AUTHORITARIAN ATTITUDES: COMPARISON OF THE FACTOR PATTERNS FROM SEVERAL POPULATIONS.

(L. C. Card No. Mic 59-6475)

Larry Dennis Cannon, Ph.D.
Purdue University, 1959

Major Professor: H. H. Remmers

This study was designed to investigate the stability of factors underlying an authoritarian attitude scale consisting of 18 items. Previous research with the instrument, called the F' Scale (Struening, 1957) led to the development of three factors:

I' authoritarian religious submission
II' cynical and suspicious view of the human environment
III' agressive authoritarian nationalism

The sample used in the previous research consisted of faculty members of a large midwestern university.

The same instrument was administered to faculty members from 23 Indiana colleges and universities. On the

basis of number of respondents, five of these institutions were selected for the present study. Item responses were intercorrelated for each of the schools, producing five 18 by 18 matrices of tetrachoric coefficients of correlation.

Each of these 5 matrices was factor analyzed, and 3 factors accounting for the most variance were selected from each of the analyses. Each of these sets of 3 factors was rotated analytically, using the varimax criterion.

The 3 factors thus obtained from each of the five schools were compared, in terms of items loading highest on them, with the three factors from the large midwestern university studied in the previous research, in order to determine the stability of the factors. The three factors, A, B, and C generally shared similar items with Factors I', II', and III' (from the large midwestern university), respectively, indicating that Factors I', II', and III' are reasonably stable over several populations. Factor II' was the most stable or invariant over the several populations.

Factor A, which in each of the five schools was similar to Factor I', was in several schools also similar to Factor III'. Factor C, in each of the five schools similar to Factor III', was in several schools similar to Factor I' as well. Thus Factors I' and III' appear not to be as stable as Factor II'.

It was suggested that item content might be responsible for this lack of factorial invariance, since in constructing the F Scale (some of the items from which were used in the F' Scale used here) Adorno, et. al. (1950) attempted to develop items which would measure more than one facet of authoritarianism at a time.

Microfilm $2.50; Xerox $5.20. 102 pages.

PSYCHOLOGICAL ATTRIBUTES OF OLD AGE AS MEASURED BY THE COPPLE SENTENCE COMPLETION TEST

(L. C. Card No. Mic 59-6197)

Richard Key Drewery, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor George Copple

In the early history of psychological testing, sentence completion tests with rather brief omissions were used to assess intellectual ability and achievement. The major current use of sentence completion tests is as a projective technique to study attitudes and personality variables. These tests differ from the Copple Sentence Completion Test (CSCT), since their stems are "loaded," more highly structured, and are designed to measure specific content areas.

The CSCT was designed to measure "effective intelligence" and studies have demonstrated high inter-scorer consistency, a high split-half reliability, and moderate test-retest reliability. Validity studies have shown moderate correlation of effective intelligence scores with measures of general intelligence, and usually higher correlations with chronological age and grade placement of children, classroom grades, success in a school of social work, and other measures.

The psychological study of old age has been relatively neglected, especially in the application of projective techniques to the problem. The older subjects are said to be slow, inefficient, less productive, poorly motivated, intellectually impotent, stereotyped, poorly controlled, regressed, lacking in abstraction and originality, and having constricted interests.

The problem selected was to attempt an extension of the usefulness of the CSCT to measure not only effective intelligence, but also other intellectual aspects, abstractive interests, social and personal attributes as related to the process of aging in normal individuals. A series of new scores was devised to measure the attributes suggested in the hypotheses. It was hypothesized that effective intelligence, productivity, efficiency, abstractive abilities and interests, relative importance of people, importance of social interaction, and actual social participation would decline with aging as concreteness, individuality and isolation, self-absorption and egocentricity would increase.

Seventy-two persons between sixty and eighty-six were compared with an equal number of control subjects, all of whom were children of the older group and between the ages of twenty and forty-six. There were twice as many women as men in the samples, but each group included the same proportion of the sexes. Participation of the subjects was voluntary and most were interviewed in their own homes. None were in hospitals, rest homes or other institutions. The median level of education in the samples appeared to be similar to that of the general white population from whom they were drawn.

The CSCT, a thirty item test requiring the subject to complete the stems to the best of his ability, was individually and orally administered, according to standard instructions; and a record covertly kept of the total testing time. This was followed by the administration of a self-reported, estimated social participation check list and the collection of personal data. Protocols were separated for blind scoring by the author on all dimensions and on effective intelligence by one other inexperienced judge and by an experienced CSCT judge. A Kendall coefficient of concordance showed highly significant agreement among the three scorers.

The Wilcoxon matched-pairs signed-ranks test was used to evaluate the significance of group differences. All of the hypotheses relating to intellectual aspects were confirmed. The younger group had more effective intelligence, was more productive and very much more efficient. The abstract category was poorly defined and results were not significant, but there are suggestive indications that vague content is more characteristic of the aged and good abstraction, of the young. The old were found to be more egocentric and the similar measure of self-absorption also approached significance. No significant difference was found between the groups in the relative importance of people, importance of social interaction and individuality and isolation; but this was found to be consistent with a similar lack of a difference in the criterion measure of the actual social participation.

Microfilm $2.50; Xerox $4.60. 88 pages.

PSYCHOLOGICAL TEST DIFFERENCE SCORES AND PREDICTION

(L. C. Card No. Mic 59-4415)

Dale Nelson Dunlap, Ph.D.
The Claremont Graduate School, 1958

For many years psychologists have been engaged in a search for adequate techniques of profile analysis of psychological tests. Frequently the differences between scores on tests have been employed as a basis of analysis. The research results using this difference score technique have been ambiguous or contradictory. No clear cut explanation of this situation is available. This thesis attempts to offer such an explanation.

By surveying representative studies which employ the difference technique it is shown that:

1. Differences between test scores are assumed to be more powerful predictors than are the scores themselves.
2. Differences are assumed to make an unique contribution to prediction.

Consequently, the hypothesis investigated is: A difference scale is a more efficient predictor of a criterion than single or multiple correlational methods when linearity of regression obtains between all of the variables.

This hypothesis presents a problem of methodology. A formula is developed for the correlation of a difference scale and a criterion. By comparing prediction, within the range of possible situations it is shown that the difference scale method is a less efficient predictor than is multiple correlational method under all conditions except where the test scales themselves correlate either perfectly or non-significantly with the criterion. It is shown that these results obtain for profiles composed of multiple tests and differences as well as for the simplest profile, the differences of two tests.

The hypothesis is not supported by the findings of this investigation.

The findings are confirmed by data presented from an analysis of the test scores of 334 male and 350 female subjects.

The findings of this study are used as a basis for concluding that the use of difference methods in profile analysis research will lead to needlessly inaccurate results. Also they are viewed as supporting concepts of intelligence which emphasize unique rather than global concepts. It is pointed out that this simple error of assumption in methodology has been employed in much research to support constructs currently in use. Appropriate methodology might or might not support these constructs as the inappropriate techniques have done.

Finally, it is stated that the desertion of this difference method by many researchers, just because it was not productive, is no guarantee that newer methods will not contain the same or similar errors in method. Therefore the findings of this thesis complete a significant gap in the knowledge of psychological research methods.

Microfilm $2.50; Xerox $5.20. 101 pages.

THE SIMPLIFICATION OF COMBAT AIR CREW CRITERIA WITH SPECIAL REFERENCE TO RANK-ORDER RATINGS

(L. C. Card No. Mic 59-5357)

Margaret Frances Estep, Ph.D.
The Ohio State University, 1951

Among the several areas of contribution by psychologists to the military program are the selection, classification, placement, and training of personnel. Effective testing of research in these areas depends upon identification of the successful performance behavior to be duplicated by future groups of personnel. The end valuation of such techniques and procedures is their relationship to the successful accomplishment of the military goal.

In practice, adequate criteria under combat conditions are hard to obtain, and the worth of the criteria so obtained is often negated by circumstances beyond the control of research workers. In the past, in lieu of combat criteria, more available measures have been used without knowledge of their relationship to the ultimate goals of the military establishment.

Many criteria commonly used in business and industrial research projects, such as the output per unit of time, the quality of production, and employee turn-over, are not feasible for use in the evaluation of psychological techniques for combat air crews. The four most common categories of combat criteria include objective measures of combat proficiency, records of administrative actions in combat units, ratings based on direct and systematic observation of combat effectiveness, and ratings based on general impressions, reports, and incidental observations.

In the research study reported here, the third of these criteria, ratings based on direct and systematic observation of combat effectiveness, was used.

There are two points of view about criteria which are suitable for use in the evaluation of small groups working as teams throughout the armed forces. One is that a group such as the combat air crew works as a team, and must be evaluated as a team, since its effectiveness depends upon the interaction of its members. The other point of view reflects the administrative need to transfer crew personnel in order to accommodate rotation of tours of duty, replacements in training and in combat, etc. These conflicting points of view can be tested by the question, Are the group characteristics of a number of individuals performing a coöperative task, as in a combat crew, adequately explained by summing up the characteristics of the individual members of the group? In the present study, data collected in a combat theater made it possible to essay some preliminary answers to this question.

The data collected were rank-order evaluations of the proficiency of medium bombardment combat air crews and crew members. Thirty combat air crews were rated by seven raters on nine variables of proficiency; 330 individual crew members of the 30 crews were ranked by two to four raters with respect to the appropriate variables from the original list of nine; in addition, the seven crew raters evaluated each other's ability to rate the variables (this may be considered as an indication of their familiarity with the crews).

The variables on which the crew ratings were gathered were:

1. First Over-all Rating: Which crew is best in contributing to the over-all mission of the Air Force?
2. Which crew is best in leading a formation bombing attack (visual)?
3. Which crew is best for individual interdiction bombing?
4. Which crew demonstrates the best teamwork?
5. Which crew is best for a mission which must be flown in instrument weather?
6. Which crew is most conscientious and determined to accomplish every mission?
7. Which crew is most dependable in the handling of a sudden emergency situation?
8. Which crew is best in radar bombing?
9. Second Over-all Rating: Which crew is best in contributing to the over-all mission of the Air Force?

The seven raters were the Group Commanding Officer, the Group Executive Officer, the Group Operations Officer, the Group Bombardier Officier, and three Squadron Commanders. Each rater was given 30 cards which contained identifying information about each crew. The ratings were done by sorting the cards for each variable one at a time.

Reliability of the Raters' Ratings

A central problem to be considered concerns the simplification of the rating process, both in terms of the variables used for rating purposes and the number of raters. Analysis of the factorial composition of the variables should yield an answer to whether fewer variables could have represented the ratings. It may be possible also to use fewer raters and yet obtain adequate ratings; the question whether or not this is feasible can be approached by showing the relationship between the reliability of a rater's ratings (in terms of how closely he agrees with the other raters) and the degree to which his familiarity with the men enables him to rate them on a particular variable. If a rater's ratings have shown acceptable reliability and if he is also judged to be able to rate the crews on a particular variable, he may be selected as one of a fewer number of raters to do the ratings in the future.

A secondary problem involves the question of whether it is more useful to combine individual ratings into an over-all rating for the crew or to rate the crew as a unit. One consideration in the choice of rating procedure is administrative ease in gathering the ratings. A second consideration is statistical reliability. A third is simplicity in performing an analysis of the ratings obtained by the two methods. The analysis of the data in the study will be made in the light of the several considerations involved in choosing one or the other of the rating procedures.

An appraisal of the reliability of the ratings of the crews on all nine variables was accomplished by comparing each rater's ratings with every other rater's ratings. For all variables combined, the reliability between raters ranged from a coefficient of .67 to .95. (Only two of the rater-rater reliability coefficients were below .82.) Coefficients of correlations between pairs of Group officer raters generally appeared to be higher than coefficients between the Squadron Commanders, suggesting that Group officers may be the more reliable raters of performance under combat conditions.

The reliability of the raters was next studied variable by variable, yielding a range of average correlation coefficients for each of the nine variables from .59 to .82 (these average coefficients were obtained by using z-transformations). The matrices of intercorrelations between raters for each of the nine variables were analyzed by Thurstone's Complete Centroid Method. Only a general factor was found in all of the variables except one, suggesting that the raters tended to agree in their interpretation of the variables. The exception was Variable 6, Which crew was most conscientious and determined to accomplish every mission? Reliability of this variable ranged from coefficients of .28 to .85, with an average coefficient of .59. Two factors emerged from the matrix which appeared to represent a split between Group officers and Squadron officers in rating behavior. The variable seemed to contain ambiguity inasmuch as it was variously interpreted by the two groups of raters. From inspection of the factor loadings, it can be stated that the ratings made by Group headquarters officers tended to agree more closely with those of the other raters in the group and probably should be considered more reliable than the ratings made by Squadron officers. The Group officers were most in agreement with the majority ratings in this order: Commanding Officer and Executive Officer ($r = .95$); Group Operations Officer ($r = .93$); and Group Bombardier Officer ($r = .91$).

Factorial Composition of the Variables

A matrix of intercorrelations was prepared between pairs of the nine variables using the sum of the seven raters' ratings as gross scores. All of the correlation coefficients were high, between .83 and .98. This matrix was factored by Thurstone's Complete Centroid Method. The purpose of this analysis was to show the general order of magnitude of the correlations between the variables, to find out how many factors might be represented in the nine criterion variables, to identify which variables were most representative of each factor, and to identify the variables most typical of all the criterion rankings.

A general factor and a residual factor were extracted. Almost all of the variance in the correlation matrix was taken up by Variable 9 (the Second Over-all Rating), Variable 1 (the First Over-all Rating), Variable 2 (formation bombing), and Variable 3 (individual interdiction bombing). The general factor seemed to depend upon criterion variables which directed the raters' attention to the crew's performance as an individual crew, as distinguished from its performance as a crew flying a mission with several other crews. The residual factor was interpreted as a ranking of an aircraft and its crew as a member of a group of aircraft flying a mission together in some coördinated program. Because of their high loadings with the general factor, Variables 9, 1, 2, and 3 may be designated as the most representative variables.

Another approach to the reduction of the number of variables was to determine which ones were most reliably rated and in closest agreement with the ratings on all other variables. Variable 9, the Second Over-all Rating, correlated .99 with the sum of the ratings given to the crews on the remaining eight variables. Variable 1, the

the First Over-all Rating, correlated .98 with the sum of the ratings given to the crews on the remaining eight variables. Variable 9 was found to be the most reliably rated variable (average coefficient, .82) and Variable 1, the First Over-all Rating, was the next most reliably rated (average reliability coefficient, .75). A summary of the findings obtained so far leads to the conclusion that ratings by one or two Group officers, on Variables 9, 1, and 2, yielded about the same ranking of the crews as ratings on all variables, by all raters. The correlation coefficient was .96.

The question whether it is more useful to rate the individuals of a crew and combine their ratings into some form of over-all rating for the entire crew or whether it is better to rate the crew as a unit was studied. The score used to represent the crew's over-all rating was the sum of the ranks assigned to the crew by the Commanding Officer and the Executive Officer on Variables 1, 2, 3, and 9. To represent the individual ratings, only the rank given on the Second Over-all Rating, Variable 9, was used (this was the most reliably rated variable used to evaluate crews and inferred to be the best variable for rating individuals). Individuals in the following five crew positions were rated: Aircraft Commander, Co-pilot, Bombardier, Navigator, and Radar Observer. The sum of the ratings given to these five individuals on Variable 9 formed the rating for the crew. The correlation coefficient between the sum of ratings of the individuals and the rating given to the crew of which they were a member was .76.

Reports of other military studies have shown that ratings of a crew reflect largely what the rater thinks of the Aircraft Commander. This relationship is confirmed in this study; the correlation coefficient was .80. The average reliability coefficient of ratings given to the Aircraft Commanders was .79. The average reliability coefficient of Co-pilots' ratings was .68. Co-pilots' ratings correlated .02 with the ratings given to the crew of which they were a member, a finding which has also been reported by other research workers. Various guesses have been made as to why this is so. One is that the Co-pilot may be a new man added to a more experienced crew. Another possible explanation is that his ability is not often demonstrated or observed, since he has little to do unless the Aircraft Commander gets hit or is temporarily prevented from handling the controls.

Data similar to those already described were gathered in a second combat theatre. Ratings in the second location had an average reliability coefficient of .57, as compared with .71 for the first location. The variable most reliably rated in the second location was the First Over-all Rating (the average reliability coefficient was .73). The next most reliably rated variable was the Second Over-all Rating (the average reliability coefficient was .70).

A matrix of the intercorrelations between all pairs of nine variables yielded a general factor in the second location. Variable 1 (the First Over-all Rating), Variable 2 (formation bombing), and Variable 5 (flying an instrument mission) were the variables with the highest factor loadings. There is considerable similarity between the factorial composition of the variables in the first location and in the second. In the second location, also, there was confirmation that the ratings of the Aircraft Commander were about the same as the ratings given to their crews ($r = .71$) and that the Co-pilots' ratings have no correlation with the crew ratings ($r = .00$).

In summary, analysis of these data indicates that the combat air crews could have been adequately ranked merely by having them rated on their over-all contribution to the mission of the Air Force by two Group officers, one of them preferably the Commanding Officer. This conclusion is warranted because in two situations the over-all rating takes up most of the variance contained in the criterion variables.

The study also showed that it is more expedient to evaluate the crew as a whole than to obtain ratings on the individual crew members, from the standpoint of ease in gathering ratings and performing the necessary statistical analysis of the data. A third factor affecting this finding was that it was relatively easy to find raters able to rate the effectiveness of the crews (particularly Group headquarters officers), but it was much more difficult to find any rater familiar enough with the individuals to rate them.

Microfilm $2.50; Xerox $4.80. 91 pages.

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EFFECTS OF REINFORCEMENT UNDER TWO LEVELS OF INFORMATION

(L. C. Card No. Mic 59-6098)

Vahak Gadarian, Ph.D.
The University of Florida, 1959

The purpose of this study was to evaluate the relative effectiveness of different type reinforcement situations—reward, punishment, mixed reward and punishment—under conditions of limited and more complete information.

The subjects used in the study were 60 undergraduate students; 39 males and 21 females, divided into six groups of 10 subjects each.

The primary apparatus was a large circular target, placed flat on a classroom floor, consisting of a bull's eye and eight concentric rings around the bull's eye. The rings of the target were numbered outward, starting from the bull's eye, from 1 to 8, with the bull's eye being O. The entire target was sectioned into twelfths and numbered, similar to the face of a clock, from one o'clock to twelve o'clock. There were in addition to the target, 16 palm-size ten-ounce sand bags; a stool, placed at a marked position 15 feet from the bull's eye; and an off-balance fan to mask the sounds of the falling bags.

The subjects were assigned to one of six groups on the basis of the roll of a die. The groups differed from each other on the basis of kind of reinforcement or amount of information. Consequently, there were two reward groups, two punishment groups, and two mixed reward and punishment groups; one out of each set of these groups was given limited information, while the other was given more complete information.

The procedure involved blindfolding the subjects throughout the experiment so they would not see the room or the target. Each subject had ten daily sessions and 32 tosses each session. The subject's task was to learn to toss the palm-size sand bags, blindfolded, at the target. Scores were kept in terms of the numbered ring in which the toss ended; the lower the score, the greater the learning. The subjects were reinforced—either rewarded,

punished, or both--and given information--either limited or more complete--on eight of their 32 daily tosses in accordance with their assigned group.

The experimental design included an analysis of variance of amount of information (limited or complete), type of reinforcement (reward, punishment, or both), daily sessions, and all interactions. Significant F's were obtained for the variances between sessions, between type of reinforcements, and between amounts of information. The analysis of variance also yielded a significant F for the interaction between amounts of information and type of reinforcements.

Conclusions

(1) Punishment was more effective than reward under either level of information.

(2) The more complete information groups were significantly better than the limited information groups.

(3) Under conditions of limited information, the mixed type of reinforcement was most effective in inducing learning.

(4) Under conditions of more complete information, the consistant and sole use of punishment was the most effective reinforcement in inducing learning.

Microfilm $2.50; Xerox $3.00. 53 pages.

ORGANIZATION IN RECALL

(L. C. Card No. Mic 59-4424)

Don Martin Gottfredson, Ph.D.
The Claremont Graduate School, 1959

An historical review of conceptions of memory led in this dissertation to proposals toward a more adequate theory of memory. This required a review of associationism, a brief examination of the influence of neurology, of early experimental studies of learning and memory, of the impact of Gestalt psychology, of various "trace" theories of memory, and a discussion of current neurophysiological interpretations of learning. This review led to proposals utilizing hypothetical brain events. A set of postulates led by derivation to numerous hypotheses which were tested experimentally.

An attempted replication of an earlier conclusion that symmetrical figures are more often recalled than asymmetrical ones was unsuccessful, though the trend of results was in the expected direction.

No relationship was observed between skin conductance (taken as a measure of autonomic nervous system activation) and symmetry of stimulus figures or recall of geometrical figures. A hypothesized relationship between recall for English words and skin conductance scores taken at the time of stimulus presentation was not confirmed. Suggestive evidence indicated, however, that under conditions of increased skin conductance with a change in task recall is positively related to skin conductance.

Subjects recalled increasingly more "pseudo words" as these approximated the sequences of letters found in English. Also, "pseudo words" most nearly resembling English were more often recalled when subjects were first required to recall English words. In addition, frequency of occurrence of English words was found positively related to recall.

These results were discussed in terms of the theoretical framework suggested, and implications for further research were noted. Limits to generalization from the results are set by the nature of the samples of subjects and stimulus objects employed. However, the method employed of presentation of complementary stimuli (e.g., symmetrical versus asymmetrical patterns) to test for differences in availability for recall was suggested as a fruitful technique for the further study of memory.

Microfilm $2.60; Xerox $9.00. 200 pages.

FACTOR ANALYSIS OF CERTAIN APTITUDE AND PERSONALITY VARIABLES

(L. C. Card No. Mic 59-3522)

Lilian Khan, Ph.D.
University of Southern California, 1959

Chairman: Professor Ruch

The purpose of this study was to ascertain the interrelationships among personality and aptitude test variables that were administered to a group of 110 salaried workers in a large steel company. It was also proposed to investigate to what extent construct validity could be substantiated relative to the hypotheses formulated in terms of the supporting evidence from the factors identified and from the extent of the correlation (loading) of the test measures with these factors.

The hypotheses formulated were: (1) There are intercorrelations between personality and temperament measures and aptitude measures. (2) These intercorrelations can be described in terms of a small number of relatively independent psychological dimensions identifiable as common factors. (3) The factors as described, or defined, by the group of test variables correlated with respect to each of them serve to substantiate construct validity of the cognitive and affective dimensions underlying the correlated test variables.

From the matrix of the intercorrelated test variables the following factors were hypothesized: (1) verbal comprehension—an ability to understand the meanings and usages of words; (2) spatial visualization—the ability to manipulate objects mentally in two or three dimensions; (3) numerical facility—an ability to do simple numerical operations accurately and quickly; (4) realism—a characteristic reaction of an impersonal, dispassionate individual; (5) aggressive-active behavior—a sense of mature self-control with social conformity; (6) social adaptability—a tendency to have friendly relationships with those who are around one; (7) impulsivity—an individual's lack of inhibitory control or lack of restraint; (8) emotional maturity—an ability to control one's impulses (the emotional maturity factor possibly representing a bipolar trait such that impulsivity in (7) is at the opposite or negative pole); (9) outer control—a well-integrated personality, in which the emotional expressions are acceptable to society.

The tests administered included three major units: the Guilford-Zimmerman Temperament Survey, the

Structured-Objective Rorschach Test, and the Multiple Aptitude Tests. Intercorrelations were calculated from stanine scores; principal axes were extracted, and their rotations to Kaiser's analytic criterion were effected through use of an electronic computer.

Findings. The intercorrelations of the thirty-four variables showed that, although there were statistically significant correlations within each of the three major test units cited, there were no significant correlation coefficients between pairs of measures selected from different test units. Within each of the three batteries many intercorrelations of the separate measures were significant.

Eleven factors were identified as (1) general reasoning—general intelligence similar to Spearman's g factor; (2) practical realism—a rational, nonemotional approach in solving problems; (3) social adaptability—behavior concerned with interpersonal relations; (4) empathic ability—behavior manifested in one's understanding oneself as well as others; (5) social dominance—a tendency not only to be interested in social activities but also to act as a leader; (6) low intellectual ability—a lowered intellectual as well as emotional control; (7) emotional immaturity—lack of social sophistication; (8) specialized spatial perception—a mental manipulation and transformation of objects; (9) reflectiveness—a tendency to be a thinking introvert; (10) impulsiveness—an infantile but not uncontrolled emotional reaction, the opposite of restraint; and (11) conventional maturity—a pattern of behavior in conformity with social expectation. Of the eleven factors obtained from the analysis, eight essentially corresponded to the factors hypothesized.

Conclusions. Thus, it may be concluded that from the evidence obtained about the factors extracted in the analysis, the constructs underlying the observed correlations among the test variables were substantiated to a considerable degree. However, the constructs were for the most part limited to particular types of measures—a finding which might reflect unique properties of the common format of large groups of test items.

Microfilm $2.50; Xerox $6.00. 124 pages.

DOGMATISM RELATED TO ATTITUDES TOWARD ADOLESCENCE AS AN INSTITUTION

(L. C. Card No. Mic 59-6492)

Milton Herbert Maier, Ph.D.
Purdue University, 1959

Major Professor: H. H. Remmers

The purpose of this investigation was to help establish the construct validity of Rokeach's dogmatism scale. Dogmatism was defined as rejection of disbeliefs, belief in absolute authority, intolerance of others, and belief that the present is unimportant. A scale was constructed to measure attitudes toward adolescence as an institution, which is defined as the values and behavior stressing reliance on the peer group. Dogmatic adolescents were predicted to be (1) more intense and (2) more consistent in either accepting or rejecting teenage norms than nondogmatic youth. The data were collected from a nationwide sample of high school students. The hypotheses were tested by a factorial design. The amount of intense opinionation and consistency of rejection and acceptance were the independent variables; dogmatism scores were the dependent variables. Neither hypothesis was confirmed by the results.

Analysis of the scales designed to measure dogmatism and attitudes toward adolescence as an institution revealed that the scales measured content very little. An extreme response set was an important source of variance in both scales. The correlation between the number of extreme responses chosen in both scales was .54.

The dogmatism items were factor analyzed and five factors extracted. These were rotated using the varimax criterion. The labels attached to the factors were: (1) need for respect; (2) emotional loyalty to the in-group; (3) personal commitment to a cause; (4) emotional loyalty to a task-oriented group; and (5) hostility. These five factors accounted for only 16.8% of the total test variance. The average item intercorrelation was .07. The hypotheses were tested with each factor score. None of the factors was related to attitudes toward adolescent norms in the predicted manner.

The reliabilities of the five factor scores ranged from .401 to .550. The reliability of the adolescence scale was .88 for the total. These were estimated by internal consistency formulas.

An extreme response set was not expected in either scale. An acquiescence was expected to be prevalent in the dogmatism scale since the items were rather general and all scored so that agreement resulted in a high score. The content of the adolescence items was expected to be very relevant to high school students, which would tend to preclude response set variance. Both the dogmatism and adolescence items were written so vaguely that most could be answered from several frames of reference.

The discussion of the results stresses the importance of adequately defining the constructs before attempting to measure them. The contribution of response style to test variance should be assessed independently of that accounted for by test content. Other conclusions derived from this investigation are:

1. The construct of dogmatism was tested by this research. The construct is not well enough defined to permit a reasonably precise measure of it. Before further work is done with the construct, its nomological net should be tightened.
2. The research herein reported serves only as a preliminary to an investigation of the relationship between dogmatism and intense opinions.
3. The components and interaction effects of response style should be identified. Their effect should be taken into account in a measure of any construct.
4. Any conclusions about constructs reached on the basis of results which have part of their variance contributed by response style are suspect. Both the experimenter and reader should be aware of the possible influence of response style. Response style may serve to enhance or attenuate an observed relationship between sets of scores.

Microfilm $2.50; Xerox $17.00 149 pages.

THE TEENAGER'S CONCEPTION OF MENTAL ILLNESS

(L. C. Card No. Mic 59-6493)

Noel Gene Markwell, Ph.D.
Purdue University, 1959

Major Professor: Dr. H. H. Remmers

The purpose of this study is to investigate what the American teenager thinks about various aspects of mental illness. It is designed to complement previous surveys of adult opinion and provide useful information for the mental health educator.

A questionnaire was developed in consultation with experts in relevant disciplines to measure the teenager's conception of the following: 1) the mental hospital, 2) the mental hospital patient, 3) mental hospital personnel, 4) the former mental hospital patient, 5) the prognosis of mental illness, 6) the normal-abnormal continuum, and 7) the importance of various etiological factors. The questionnaire was administered to a national sample of 15,000 high school students through the facilities of the Purdue Opinion Panel.

Results were analyzed on a stratified-random sample of 2,000 students. Percentage response was computed for each item and tests of significance were made across six sub-groups of the sample using analysis of variance for categories of items and chi^2 for miscellaneous items.

The results suggest that the teenager's conception of mental illness is encouraging in many ways but contains a substantial number of undesirable qualities. And it apparently differs considerably among various sub-groups of the sample, especially socio-economic groups. Speculations were made about possible reasons for these results and implications for mental health education were suggested. Microfilm $2.50; Xerox $7.80. 166 pages.

AN ANALYSIS OF FORMAL ASPECTS OF MEMORY FUNCTIONING UNDER DIFFERENT TYPES OF STRESSORS

(L. C. Card No. Mic 59-6190)

Joseph Mayer, Ph.D.
Clark University, 1959

Supervisor: Robert W. Baker

The research involved a formal analysis, within the framework of developmental theory, of memory functioning under different kinds of stressor conditions. Differences among stressor conditions as reflected in their effect upon memory were focused upon, as was the nature of memory functioning itself.

Stressors were employed which varied amount, and time, of arousal of negative emotion in relation to the act of recall. It was predicted that both interference with recall and arousal of strong negative emotion would lead to the more frequent use of developmentally less mature behaviors, and that emotion-arousal before recall would carry over into recall to alter memory.

The developmental principle that guided the analysis of memory held that mature memory functioning is marked by adequate differentiation between the given organization of the learned material and both the stylistic context within which recall occurs, and the more personal aspects of the self such as drives and emotions.

Fifty college students, in five experimental groups, listened to one presentation of two narrative passages. After a five minute interval all groups reproduced the passages. The five groups, containing five males and five females in each, were; (a) control, which was engaged in five minutes of innocuous conversation during the interval between perception and recall, (b) interval non-emotion-arousal, which viewed relatively non-emotion-arousing pictures during the interval, (c) interval emotion-arousal, which viewed emotion-arousing pictures during the interval, (d) recall non-emotion-arousal, which was engaged in innocuous conversation during the interval and reproduced the passages while viewing relatively non-emotion-arousing pictures, and (e) recall emotion-arousal, which was engaged in innocuous conversation during the interval and reproduced the passages while viewing emotion-arousing pictures.

Three classes of dependent variables were analyzed: achievement variables; stylistic variables, dealing with the style or manner with which recall was given; and semantic variables, dealing with the degree of adherence of the meanings represented in memory to the original meaning of the passages. It was felt that the stylistic variables represented an intrusion of personal style into the organization of the learned material, and that more severe meaning changes represented a similar lack of differentiation between the learned material and more personal aspects of the self.

The experimental predictions concerning the effects upon memory of the different kinds of stressor conditions were, in general, supported. On the basis of the results it was proposed that distraction be viewed as an internal state originating from interfering, "external" stimuli or from "internal" events (e.g., emotion), and that this distraction, regardless of origin, diverts energy from the cognitive operations required for the task at hand, thus leading to developmentally less mature behaviors.

Two sex differences appeared: control females exhibited more developmentally less mature behaviors than either control males or other groups of females; otherwise, females appeared to be less affected than males by the experimental stressor conditions.

Three developmental levels of memory functioning, ordered on the basis of amount of conscious control and amount of differentiation between the learned material and other aspects of the self, were proposed. The highest level, characteristic of memory functioning in normal subjects under ordinary circumstances, tends not to be affected by the stressors used in this study. Behaviors at the middle level are less frequently seen in normal individuals under ordinary circumstances, and these behaviors tend to increase in frequency under the stressors employed. Behaviors at the lowest level, representing least differentiation between the learned material and other aspects of the self, are seen in severe pathological states but are seldom seen in normal individuals except under very adverse circumstances. Very few of these behaviors appeared in this study under the stressors employed.

Microfilm $2.50; Xerox $6.00. 121 pages.

A DEVELOPMENTAL STUDY OF MOTIVATION AND REACTIONS TO FRUSTRATION

(L. C. Card No. Mic 59-5956)

Leah Brooks McDonough, Ph.D.
Michigan State University, 1958

Major Professor: M. Ray Denny

The present study was designed to investigate possible age and sex differences in strength of reaction to frustration as related to motivational level. Specifically, it was hypothesized that(1) frustration would result in increased performance; (2) older children would respond more strongly than younger children to frustration in a competitive task; (3) boys would respond more strongly than girls in a competitive task; (4) response to frustration in a non-competitive, tangible reward task would remain relatively constant in all age groups; (5 and 6) strength of response to frustration in either the reward or the competitive task would be related to the relative strength of that motive for the particular child as shown in his daily life, according to mothers' ratings of the child.

The subjects were 100 children in five different age levels: 3-4, 4½-5, 6-6½, 7½-8, 9-9½. In each age group five boys and five girls were given a marble board task under competitive conditions ("to find out who in your class can fill the board the most times"), and five boys and five girls performed the same task for a tangible reward (a small toy) rather than peer competition. After every trial the subjects hit a plunger on the apparatus.

Following two successful trials the subjects were arbitrarily frustrated (prevented from completing the task) without their realizing the arbitrariness of the situation. They were led to believe that they had exceeded the time limit. Frustrated trials were continued until a specified criterion was reached. Then two more successful trials were given. Speed of performance and force with which the subjects hit a plunger were recorded for every trial. Response to frustration was measured by the change in speed of performance and force of response immediately after introduction of frustration (post frustration latency, post frustration amplitude). In addition, any cumulative effects of repeated frustration were measured by the average speed and amplitude for frustrated trials as compared with the pre-frustration trials (cumulative latency, cumulative amplitude). A fifth measure of response to frustration was the number of trials the subject performed before reaching the criterion (persistence).

Mothers' responses on a rating scale resulted in the child's being classified as relatively more reward-oriented or competition-oriented in his daily life.

The initial hypothesis was not confirmed and neither were the subsequent ones, with the exception of 4. These generally negative results were due in part to the fact that hypotheses 2,3,5, and 6 were dependent on the initial hypothesis. Measures of response to frustration were based on the assumption that increased performance would follow frustration. Actually, although there were some indications of motivational differences between groups in terms of initial performance, they did not show in our measures of response to frustration. Some subjects increased their performance following frustration, some showed a decrement, and others changed not at all. However, a general inhibitory effect of frustration was suggested. Microfilm $2.50; Xerox $5.40. 110 pages.

DISPLAY ARRANGEMENT, NUMBER OF CHANNELS AND INFORMATION SPEED AS RELATED TO OPERATOR PERFORMANCE.

(L. C. Card No. Mic 59-6503)

Paul Louis Olson, Ph.D.
Purdue University, 1959

Major Professor: E. J. McCormick

A research problem in human engineering in which the influence of several display variables on the ability of subjects to cope with information presented visually is investigated.

Subjects were faced with an array of eighteen dials, which could be arranged in various patterns. Different amounts of information, in terms of deviations from the null points of the dials, could be programmed through all or some of the dials. The subject's performance in dealing with the information was measured in terms of the time it took him to note a deviant dial and return it to the null point. While monitoring the dials, the subject was required, simultaneously, to perform on a simple tracking task. His performance on this task was measured in terms of time off the track.

Specifically, the variables used in the study were:

1. Rate or speed. This factor consisted of the amount of information programmed through the dials in a given unit of time. There were three levels of this factor, namely, 48, 36, and 24 dial deviations in a four minute experimental period.

2. Load. The number of dials employed at a given time constituted this factor. The levels of this factor were 18, 12, and 6 dials.

3. Arrangement. Four different, symmetrical arrangements of the dials were used. These were: 6 rows, 3 columns; 3 rows, 6 columns; 2 rows, 9 columns; and 1 row, 18 columns.

4. Location. By connecting different timers to different groups of dials it was possible to evaluate differences associated with varying positions of dials within a given arrangement.

The two criterion measures were defined as follows:

1. Reaction time. This was the measure of the promptness of response to information presented through the dials.

2. Time off target. In an experimental period of four minutes length a subject could be off target on the tracking task any amount of time up to 240 seconds. This was the measure of his performance on this task.

Eighteen different subjects worked under each of the four arrangements. All subjects were exposed to the same nine treatment combinations, consisting of all possible combinations of rate and load.

Results indicated that all variables were associated with significant variation on both criterion measures.

The following conclusions were based on the results of the study:

1. All of the factors investigated, namely, arrangement, rate, load, and media location, are potentially important determiners of the ability of individuals to deal with incoming information.

2. A display designed to satisfy one criterion of operator performance may prove to be inadequate when considering another. The results of the study illustrate clearly that the two potentially important criteria which are investigated in it are not highly correlated.

3. Information giving media of a type which must convey their messages visually stand a much greater chance of being missed if they are placed in the observer's periphery than if they are centrally located.

4. The further down a subject must move his eyes to read information, the more his control over an eye level task will suffer.

5. The fact that placing of dials away from the most central location seems to be associated with poorer performance lends strong support to the general conception that important displays should be as centrally located as possible.

6. The more data sources (presenting information visually) with which an individual must deal, the less information, in terms of deviations from normal, he can be expected to handle.

Microfilm $2.50; Xerox $5.80. 118 pages.

MANAGEMENT DECISION-MAKING SIMULATION: A STUDY OF PSYCHOLOGICAL RELATIONSHIPS.

(L. C. Card No. Mic 59-6507)

Malcolm Mills Purdy, Ph.D.
Purdue University, 1959

Major Professor: D. C. King

An investigation of the interrelations between results from a management decision-making simulation game and academic, aptitude, and group predicted performance.

The common goal of management decision-making simulation games is to develop skills which will increase the effectiveness of the participants' decision-making. The criterion of effectiveness most commonly reported is the subjective expression of satisfaction with the training technique by the participants. While participant satisfaction is certainly desirable, the objective demonstration of relationship between performance in a management decision-making game and other relevant measures of performance is certainly critical. The author suggests that the ultimate acceptance of management decision-making simulation games as training techniques in the decision-making area depends on their demonstrated ability to increase the probability that participants will be more effective decision makers. An investigation of the relationships between and among game performance and indicated aptitudes and abilities in seemingly related areas should provide a start in the direction suggested.

The simulation model used in this study and the decisions which it required were felt to be representative of the majority of models presently available. A slight modification of the procedure and the computer program made it possible to collect and later evaluate the decisions of individual members as well as their teams. The additional variables on which measures were obtained were:

Academic performance

Tested aptitude for graduate study in business

A computed "index of similarity" between individual and team sets of decisions

Teammate's predictions of the level of individual net income

Teammates' perceptions of the degree of "influence on team decisions" which each of their teammates had exercised.

The subjects were 45 male graduate students in an industrial management graduate program whose median age was 25 years. Students from each fifth of the grade ranking were randomly assigned to three game sessions composed of three, five-man teams each.

Twelve hypotheses were formulated concerning the interrelations of the measures within each team. Tests of the hypotheses support the following conclusions.

1. Performance in decision-making is not positively related to academic performance, tested aptitude for graduate study in business, or predicted performance in decision-making.
2. Individual and team performance in decision-making are not significantly different.
3. Predicted performance in decision-making is positively related to academic performance and tested verbal aptitude for graduate study in business, but not to perceived influence on team decisions.
4. Perceived influence on team decisions is positively related to actual influence on team decisions, tested verbal and total aptitude for graduate study in business, and academic performance.
5. Verbal aptitude for graduate study in business is related to actual influence on team decisions.
6. The differences between individual and team decisions become greater with practice.

The implications of these conclusions to management decision-making simulation training and research are indicated. Microfilm $2.50; Xerox $5.80. 118 pages.

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN CONFUSION IN SEX-ROLE IDENTIFICATION AND SOCIAL MALADJUSTMENT IN CHILDHOOD

(L. C. Card No. Mic 59-3445)

Anne Ingersoll Spock, Ph.D.
The American University, 1959

This study investigated the relationship between confusion in sex-role identification and social maladjustment in boys eight and a half through ten years of age.

Confusion in sex-role identification was measured by (1) marked deviation from masculine peer norms in scores on a Masculinity-Femininity Preference Scale of Interests and Activities, and (2) clinical judgments of evidence of sex-role confusion on the Draw-a-Person Test. Social maladjustment was measured by (1) frequency of occurrence of behavior problem items on a Teachers' Rating Scale, and (2) lack of peer acceptability on a Sociometric Test. Both the Preference Scale and the Teachers' Rating Scale were developed by the investigator for the purposes of this study.

The first phase of the study was conducted with a random sample of 86 third, fourth and fifth grade boys in a

normal public school population. Within this population it was hypothesized:

1. That those boys who showed a high degree of sex-role confusion in clinical ratings on the Draw-a-Person Test would also deviate markedly from masculine norms on the Preference Scale of Interests and Activities.
2. That the group of deviant scorers on the Preference Scale and on the Draw-a-Person Test would score significantly higher than the average school group in frequency of behavior problems on the Teachers' Rating Scale.
3. That the same group of deviant scorers would score significantly lower than the average school group in peer acceptability on the Sociometric Test.

The second phase of the study compared a group of boys with clearly established behavior problems with the average school group on the two measures of sex-role confusion. The problem behavior group was composed of ten juvenile delinquents, nine and ten years of age, who were legally committed to a residential training center. It was hypothesized that the scores of the juvenile delinquent group would deviate markedly from those of the average school group on the Draw-a-Person Test and on the Preference Scale.

The differences between the groups were analyzed by the parametric t-test and by the nonparametric Mann Whitney U Test and the Median Test. These tests indicated that when the Preference Scale of Interests and Activities was used as the measure of sex-role confusion there was a difference, beyond the .025 level of significance, between the deviant and the average school groups in frequency of behavior problems on the Teachers' Rating Scale, and in lack of peer acceptability on the Sociometric Test. When the Draw-a-Person Test was used to measure sex-role confusion there was no significant difference between the two groups in relation to either measure of the dependent variable. In the comparison of the juvenile delinquents with the average school group, a significant difference, beyond the .01 level, was found between the two groups on their scores on the Preference Scale of Interests and Activities. No significant difference was found between the groups in clinical judgments on the Draw-a-Person Test. There was also no evidence of a significant relationship between sex-role confusion as measured by clinical judgments on the Draw-a-Person Test and as measured by scores on the Preference Scale in the findings either on the school population or on the juvenile delinquent group.

The results of the study suggested the possibility that the construct of confusion in sex-role identification might represent several types or levels of deviation in sex-role concepts and preferences, and that these, in turn, might be associated with quite diverse patterns of social adjustment. In cases where there was confusion in overt expression of masculine and feminine interests on the Preference Scale, there appeared to be a consistent and significant pattern of acting out behavior directed against authority figures and peers. Confusion in sex-typed preferences also seemed to be a significant component in pre-adolescent cases of juvenile delinquency. On the basis of the data on the projective drawings, however, no consistent patterns of personality functioning could be identified which were significantly related to clinical judgments of confusion in sex-role concepts on the Draw-a-Person Test. Microfilm $2.75; Xerox $9.40. 209 pages.

A FACTOR ANALYTIC STUDY OF FAMILY RELATIONSHIPS IN A GROUP OF ACADEMIC ACHIEVERS AND UNDERACHIEVERS

(L. C. Card No. Mic 59-5131)

Herbert A. Sprigle, Ph.D.
The Pennsylvania State University, 1959

STATEMENT OF THE PROBLEM

The purpose of the present study was to evaluate the factorial structure of attitudes toward child-rearing and family life to derive a set of meaningful psychological dimensions for a group of 1) Achievers, 2) Underachievers, 3) Mothers of Achievers, and 4) Mothers of Underachievers.

PROCEDURES

The research involved the isolation of a group of young men designated Underachievers who, in spite of average or above-average ability, as measured by a University aptitude test, have performed far below expectations in academic work in high school. A second group of young men was designated Achievers; they have average or above-average ability and have performed within expectations in academic work in high school. The mothers of these two groups were also used in the study. The instrument used to measure parental attitudes is called the Parental Attitude Research Instrument (PARI). It contains 115 items ordered into 23 scales. The two groups of boys were asked to respond to the questionnaire as they thought their mothers would, while mothers themselves were asked to respond in the usual fashion.

RESULTS AND CONCLUSIONS

Four 23 x 23 matrices of intercorrelations were factor analyzed using Thurstone's centroid method.

Factorial Composition of the Attitude Scales for Achievers

Factor I reveals a dimension that seems to reflect a dominating, directing, self-asserting quality of the mother.

Factor II defines a dimension ranging from the parent's desire to keep control of the child's training to a home atmosphere of companionship and genuine interest in the child as an individual.

Factor III seems to be a dimension that describes a feeling of insecurity and uneasiness in the role of mother.

Factor IV is related to a need of the mother to hold onto the child, to keep him dependent on and obligated to her.

Factorial Composition of the Attitude Scales for Underachievers

Factor I is a dimension ranging from fostering dependency and immaturity to encouragement of self-expression and independence.

Factor II reveals a complaining, pessimistic, rejecting, somewhat aggressive quality of the mother.

Factor III reflects a strong identification with the roles involved in being a mother.

Factor IV ranges from encouragement to discouragement of expression of the child's ideas and feelings.

Factorial Composition of the Attitude Scales for Mothers of Achievers

Factor I is a dimension that involves mother-child interaction with particular emphasis on training and discipline.

Factor II involves a woman's dissatisfaction with her current life situation, children, and husband, to which she reacts with hostility.

Factor III describes a dimension of democratic practices and values in child-rearing.

Factor IV reveals a dominating, somewhat hostile woman who shows concern about the child's expression of sex and agression.

Factorial Composition of Attitude Scales for Mothers of Underachievers

Factor I reveals the mother's relationship with her child and her relationship with her husband, both of which are negatively oriented.

Factor II describes numerous irritations, frustrations, disappointments, and anxieties associated with the mother role.

Factor III is concerned with obedience, conformity, and achievement.

Factor IV is a dimension that ranges from possessiveness of the mother to a relationship in which there is an expressed equality.

Several of the factors isolated corresponded to the findings of a number of previous studies, as well as mother-child relationships reported by clinical observations. Microfilm $2.50; Xerox $6.80. 142 pages.

A FACTORIAL STUDY OF CONCEPT LEARNING

(L. C. Card No. Mic 59-6449)

E. Elizabeth Stewart, Ph.D.
The University of North Carolina, 1959

Supervisor: Dorothy C. Adkins

The research was designed to investigate the question of what common processes are involved in concept-learning and in performance on paper-and-pencil tests of various intellectual abilities, particularly those in the domain of reasoning.

The variables were 32 paper-and-pencil tests and four concept-learning tasks. The paper-and-pencil tests included 15 reasoning tests and 13 reference tests for eight nonreasoning factors. The reasoning tests comprised series, analogies, classification, grouping, group-naming, and syllogistic tests and a modified-maze test. Reference tests were included for the verbal-relations, number, space 1, memory 1 and 2, perceptual-speed, and closure 1 and 2 factors.

The concept-learning tasks required the subject to learn to classify stimuli into groups. Three aspects of the tasks were varied systematically: the nature of the stimuli (figural or verbal), the nature of the solution (arbitrary or nonarbitrary), and the nature of the task activity (memorizing class names or sorting cards into groups). The variations were embodied in the tasks in the following manner: Task 1 - verbal, arbitrary, sorting; Task 2 - figural, nonarbitrary, sorting; Task 3 - figural, arbitrary, memorizing; Task 4 - verbal, nonarbitrary, memorizing. The measure of learning on Tasks 1, 3, and 4 was the number of the trial upon which the subject first made no errors; on Task 2 the measure was the time required to produce an acceptable classification.

The subjects, all paid volunteers, were 156 male undergraduates at the University of North Carolina. Each subject devoted about nine hours to attending three group sessions during which the paper-and-pencil tests were administered, an individual session at which Tasks 1 and 2 were administered, and two small-group sessions at which Tasks 3 and 4 were presented on slides.

Correlation coefficients were obtained, and six factors were extracted by the complete centroid method of factor analysis. Oblique rotation of five factors was carried out by a combination of graphical and analytical methods.

Factor A was interpreted as a perceptual factor, representing perceptual speed predominantly. Task 3 had a projection of -.35 and Task 1 a projection of -.17. The loadings of the remaining tasks were near zero.

Nineteen tests had projections of at least .25 on Factor B, including the reference tests for the second closure factor, all of the concept-learning tasks, the space test, and all of the tests intended as measures of reasoning except three verbal tests. Factor B was thought to represent flexibility in reasoning about nonverbal material and, to a lesser extent, about verbal material of a relatively concrete nature.

Factor C was identified with the verbal-relations factor. The projections of the concept-learning tasks ranged between .05 and .21.

Factor D was identified with Thurstone's second memory factor. The loadings of the concept-learning tasks were negligible.

Factor E was thought to represent facility in paired-associates memorization. Task 3 had a loading of .29. The loadings of the other tasks were small.

Microfilm $2.50; Xerox $7.00. 148 pages.

A COMPARISON OF TWO METHODS OF TEACHING WRITING IN A COURSE IN COMMUNICATION SKILLS

(L. C. Card No. Mic 59-6523)

Louis Randolph Ward, Ph.D.
Purdue University, 1959

Major Professor: Norville M. Downie

The problem which occasioned this study is a current one. Enrollments in colleges and universities are rapidly increasing, but the number of trained teachers becoming available each year is far from adequate. Particularly in classes where writing is taught, where the ratio of teachers to students has customarily been high, the problem has become acute. How can proportionately fewer teachers teach composition effectively to increasingly large numbers of students?

As an attempt toward a solution, an experiment was devised comparing two methods of teaching writing in a Communication Skills course. The crucial difference in the

experimental method was a way of handling themes which saved half or more of the teacher time normally required. In the conventional method of teaching composition, the instructor marks and grades each paper, pointing out errors and making suggestions for improvements. Students make corrections or revisions as indicated. In the experimental method the instructor reads the themes quickly, without marking them in any way, and records grades on separate slips of paper. Groups of four students read and rank four of their classmates' papers; next, each student individually marks two papers for strengths and weaknesses, anything that he thinks may help the writers; finally, the themes are returned, along with the instructor's grade slips, to their owners for review, discussion, and questions.

In order to compare the effects of the two methods of teaching writing, or handling themes, three hypotheses were formulated. These were that there would be no significant differences between gains, or losses, made by experimental and control groups with regard to:

(1) Knowledge of the fundamentals of written composition.

(2) Proficiency in writing.

(3) Attitude toward writing.

The experiment was conducted with regular classes of Communication Skills students at Michigan State University during the academic year 1957-1958. Three classes were taught each quarter, one control and two experimental; but for the main analysis of results, only one of the experimental classes each quarter was used: the one whose initial scores on criterion measures most closely approximated those of the control group. Criterion measures included an objective Writing test, an Essay test, and an Attitude scale.

The overall results were that the control group performed better on the Essay test, but not significantly so; the experimental group performed better on the Writing test and significantly better on the Attitude scale.

A supplementary analysis using all six experimental classes gave similar results except that in no case was a difference significant.

On three other measures, Reading and Listening tests and an achievement of objectives questionnaire, the experimental classes consistently performed better than the control ones, but never significantly so.

Attitudes toward written composition became significantly lower each quarter, both within the experimenter's three classes combined and, to the extent that initial score comparisons indicated a trend, throughout the Department as a whole. Microfilm $2.50; Xerox $5.00. 99 pages.

SELF-CONCEPT AS A MEDIATING FACTOR IN SOCIAL BEHAVIOR

(L. C. Card No. Mic 59-5502)

Edwin C. Wood, Ph.D.
The University of Oklahoma, 1959

Major Professor: Louis B. Hoisington

The purpose of this theoretical paper was first to provide a clear and specific meaning for the term, self-concept, and to show its place in the over-all structure of personality theory. A second purpose was to describe the act of self-conceptualizing, its origin and its function, with particular reference to the conforming and conventional behavior of the individual.

According to the theory presented, self-conceptualizing is a reflexive mind activity, consisting in the creation of a dramatic and glorified conception of self. The stimulus for such activity is the perception of an attitude toward self held by a significant other, especially a negative attitude. The natural response to such perception is self-feeling--either positive or negative, depending on the attitude. Self-feeling is distinguished from other feeling states as being self-conscious and as either ego-enhancing (positive) or ego-debasing (negative). Both states are anxiety states, and negative self-feeling, especially, is intolerable. The self-concept arises as a defensive mind activity as one reaction to intolerable self-feeling. It arises only under such conditions and is always positively charged. Its sole function is to maintain and raise self-esteem.

Once established, the self-concept serves as an internalized control over thought, feeling, and impulse, and thus as a mediating factor in social behavior: conventional and conforming. Conventional behavior is defined as behavior motivated by anxiety aroused by the impulse to behave unconventionally; conforming behavior as motivated by anxiety aroused by the impulse to non-conform. For these terms no strictly behavioral definition is possible. The conforming person has an unstable and poorly integrated self-concept, one which is directly dependent in its content on the attitudes expressed in the immediate environment. The conventional person has a stable and integrated self-concept, one which derives from early experiences, especially with parents. The conforming self-concept is essentially social in nature; the conventional one, moral. Whichever form the self-concept takes, it achieves its effects through anxiety (negative self-feeling).

Self-conceptualizing is a reflexive self-activity and is contrasted with spontaneous self-activity. The latter is characteristic of the infant, as well as of the adult when he is not self-conscious. Self-conceptualizing can thus be said to effect a structural change in the self, one which makes so-called neurotic conflict possible, and which provides the leverage for the traditional mechanisms of defense. Strictly speaking, the spontaneous self-structure has no capacity for defensive activity.

Self-conceptualizing, then, is a defensive maneuver of the self, and must always be taken in this light. The general impression of self-concept as objective awareness of self and as always implicated in the activities of the self must therefore be revised. Also, the role of the self-concept in the growth of the self toward an ideal form must be brought into question.

Microfilm $2.70; Xerox $9.20. 205 pages.

AN EVALUATION OF TWO FACTOR ANALYSIS APPROXIMATION METHODS

(L. C. Card No. Mic 59-5368)

Dale Ford Wyatt, Ph.D.
The Ohio State University, 1953

A new factor analysis approximation, called the successive residuals method, is presented. Intercorrelations among variables are not required. The method sets up a series of independent scores for persons by means of correlational regression procedures. The correlations between each variable and each of these scores represent loadings on orthogonal factors.

The successive residuals method employs the following steps to factor a set of dichotomous items:

a) Compute a total score for each person in which items are weighted 1 or 0 (T).

b) Correlate each item with T. These r_{iT} values are loadings on Factor I.

c) Obtain a total weighted score for each person in which items are weighted r_{iT} or 0 (Tw_1).

d) Correlate T and Tw_1 over persons and compute the regression coefficient for predicting Tw_1. Compute, for each person, the residual score Tw_1 minus predicted Tw_1 (Res_1). T and Res_1 correlate zero.

e) Correlate each item with Res_1. These correlations are loadings on Factor II.

f) Repeat step c) by analogy; that is, obtain for each person a total weighted score where passed items are weighted by the square root of the sum of squares of the loadings on Factors I and II. (These values represent a multiple correlation of Factors I and II with an item.) This weighted total is Tw_2.

g) Repeat step d) by analogy; i.e., predict Tw_2 by its multiple correlation with T and Res_1. In the special case of zero correlations between predictors, the beta weights for T and Res_1 equal their zero-order correlations with Tw_2. Compute for each person a Res_2 score, which equals Tw_2 minus predicted Tw_2. Res_2 correlates zero with T and with Res_1.

h) Correlate each item with Res_2. These correlations are loadings on Factor III.

i) Repeat the process until there is no variance in the residual scores.

Empirical examples and partial algebraic derivations are presented to show that this method corresponds to a factorization of the total (rather than common) variance in an intercorrelation matrix. Equal item variances are assumed. Several atypical situations are described in which the method breaks down.

The successive residuals method and the Wherry-Winer[1] method were compared empirically to the principal components method in the factorization of a thirty-four item rating scale. The former two methods were evaluated in terms of the extent to which they produced the same factors as the last method, and in terms of the amount of labor they saved.

The general conclusions were:

a) Both methods produced a fairly good approximation of the principal components factors. The Wherry-Winer method was somewhat superior.

b) Both methods effected a large computational saving, with the successive residuals method requiring slightly less work.

Microfilm $2.50; Xerox $4.60. 89 pages.

1. Wherry, R. J., and Winer, B. J. "A Method for Factoring Large Numbers of Items," Psychometrika, 18 (1953), pp. 161-179.

Abstract published by special arrangement with The Ohio State University.

PSYCHOLOGY, CLINICAL

INCONSISTENCY OF ATTITUDES IN THE FORMATION OF SCHIZOPHRENIA

(L. C. Card No. Mic 59-5632)

Andrew Berger, Ph.D.
University of Missouri, 1959

Supervisor: Kenneth B. Brown

An exploratory investigation was conducted to test the hypothesis that individuals who have shown schizophrenic reactions would (a) report significantly greater inconsistency in attitudes of their mothers than would normals or another group of maladjusted non-schizophrenics, and (b) would show higher consistency in attitudes toward non-human things and events than toward people. These hypotheses were derived from the theoretical position concerning the formation of schizophrenia proposed by Bateson, Jackson, Haley, and Weakland.

Four groups of Ss were used in the study: 20 schizophrenics, 18 maladjusted non-schizophrenics, 20 hospital employees, and 40 students.

The tests used to investigate the hypotheses were a revision of the Parent Attitude Scale, a Statements of Attitudes Regarding Nature scale, and a Frequency of Statements Scale containing double-binding statements. All Ss, except hospital employees, were tested twice in order to obtain measures of reliability. These were found to be acceptable for all the scales, except possibly the revised PAS.

The results indicated that no difference was present in the inconsistency scores for all groups on the PAS and SARN. These results did not support either hypothesis tested. Significant differences were obtained for scores on the FSS between schizophrenics and students, and also between hospital employees and students, but not between schizophrenics vs. maladjusted non-schizophrenics, or schizophrenics vs. employees. In an analysis of the 30 items on the FSS, 12 items were found to discriminate between schizophrenics and students, and five of these discriminated between schizophrenics and the other two control groups. Inspectional analysis of the discriminating items indicated a preponderance of rejecting, hostile statements, which usually left the S without choice in the situation.

The results obtained were discussed in terms of their implications for the double-bind and alternative hypotheses regarding the development of schizophrenia, and possibilities for further research in this area were considered.

Microfilm $2.50; Xerox $3.80. 70 pages.

A STUDY OF THE GENERALIZATION OF CHANGES WITHIN THE PERSONAL CONSTRUCT SYSTEM

(L. C. Card No. Mic 5349)

James Bieri, Ph.D.
The Ohio State University, 1953

The research problem was an exploratory investigation of the systematic effects of change within the personal construct system. The basic hypotheses tested were derived from some fundamental postulates of the psychology of personal constructs as set forth by Dr. George A. Kelly. The postulate most crucial to the research was the statement that the individual's psychological processes evolve toward an optimal anticipation of events. The compatibility of the general psychological concept of generalization with the theory of personal constructs, and with the process of conceptualization in particular, was elaborated and integrated into the research as an aid in formulating the hypotheses concerning generalization of change within the personal construct system. Establishing a generalization gradient and the formation of personal constructs were construed as similar processes involving the ordering of elements along a dimension ranging from greatest similarity to greatest dissimilarity to the elements from which the construct (or gradient) was formed. In order to obtain psychologically meaningful dimensions upon which generalized change could operate, the matrix method of construct system representation was employed. This method, derived from the Group Form of the Role Construct Repertory Test, produces dimensions as avenues for generalization from two of the major interrelated parts of the construct system: (1) figures or persons in the individual's psychological society and (2) constructs with which these figures become meaningful and predictable. The use of the matrix method permits these construct and figure dimensions to be ordered on a scale of similarity-dissimilarity, as perceived by the subject, in reference to the particular dimensions from which generalization of change was predicted. In order to produce the initial system-change from which other changes were assumed to generalize, a method of invalidation of predictions (controlled for each subject by validation of predictions) was incorporated as a vital part of the design. This invalidation was of two kinds: invalidation of predictions relative to the construction of figures, and invalidation of predictions relative to the application of constructs to figures. In this manner, hypotheses were set up concerning generalization of change along both figure and construct dimensions.

These hypotheses were of two major types: (1) hypotheses dealing with the generalization of change along both kinds of dimensions in relation to both absolute and relative measures of similarity-dissimilarity, and (2) hypotheses concerning the directionality of change both to the system as a whole relative to validated and invalidated dimensions, and of these dimensions in relation to the entire system.

Eighty undergraduate students in sections of a course in educational psychology at The Ohio State University were used as subjects. These subjects were divided randomly into two groups, one dealing with generalized changes of constructs, and the other with generalized changes in figures. The experimental methodology was carried out in two stages. The first part consisted of group (class) administration of a "Situations Questionnaire" and of a modified form of the Group Form of the Role Construct Repertory Test. The "Situations Questionnaire" was designed to elicit representative behavior in classroom, recreation, and job situations. The responses made on this questionnaire were the behaviors which subjects attempted to predict at a later stage in the design. The Role Construct Repertory Test provided each subject with a set of his own meaningful constructs by which he could construe the behavior of others in his attempt to predict their responses.

The second stage of the experimental procedure consisted of an individual session with each subject. The subject was asked to construe each figure in the matrix along each construct by deciding whether or not the construct was most applicable to the figure. With this set of matrix system constructions as a guide, the subject was then asked to predict the behavior of his classmates on the "Situations Questionnaire." Those subjects in the construct group made predictions based upon two different constructs of all six classmates in their matrix. The predictions based upon one of the constructs were subsequently "validated" by the experimenter, and the predictions based upon the other construct were "invalidated." The subject was then given a duplicate matrix containing the constructs and figures as presented on the original matrix. The subject was instructed to construe each figure again along each construct dimension and to make any changes necessary so that he could improve his predictions the next time. Following this, a new set of predictions was made by the subject in the same manner as before. The differences between each subject's construction of the first matrix and the second matrix provided the basis for measuring the amount of generalized change.

The results of the study indicate that except for predicting the generalization of changes as a function of similarity to validated dimensions weighted by the change in these validated dimensions, absolute scores of similarity-dissimilarity of construct and figure dimensions are likely to be of little value when considered independently. However, when the relative similarity-dissimilarity of construct and figure dimensions to validated and invalidated dimensions is considered, more consistent generalization of change is found. In general, there is greater generalization to those dimensions relatively more similar to the validated dimensions than to those relatively more similar to the invalidated dimensions. These results are tempered by the fact that this difference is not in the form of a linear relationship and that there is a sharp decline in generalized change as the extreme end of the gradient is approached. A consistent qualitative finding of the study was that the highest point of generalization for both groups occurred at a point intermediate between the midpoint of the gradient and the end of the gradient. It is possible, especially for the construct group, that this intermediate high-point is a function of the differentiating power of the construct in reference to the validated and invalidated dimensions. In any event, it appears that greatest

generalization occurs to those dimensions which are somewhat removed from the dimension undergoing change.

The results of the hypotheses dealing with directionality of change indicate that the use of the validated dimension as a reference point for predicting movement within the system is of relatively little value in such a study as this. More consistent directionality of movement was found in relation to the invalidated dimensions, particularly for the construct group. Here there tends to be support for both the contention that the invalidated construct becomes less general relative to the matrix, and that the system as a whole becomes less general relative to the invalidated construct. For figure dimensions, changes in the matrix were away from the invalidated figure but not necessarily in the direction of the validated figure. The impression is gained from inspection of the directionality hypotheses results that construct dimensions function more systematically in reference to one another than to the figure dimensions.

It is felt that this research has demonstrated the usefulness of making more explicit the contributions to one another of a perceptually oriented theory of personality and the concept of generalization in predicting human behavior. It is considered that the general methodology used in this research is capable of producing meaningful results as a method of approaching the study of the dynamics of the individual's construct system.

Microfilm $2.50; Xerox $6.40. 130 pages.

Abstract published by special arrangement with The Ohio State University.

DEPENDENCE, INDEPENDENCE, AND OTHER FACTORS RELATED TO VETERANS' REACTIONS TO AN OFFER OF PSYCHOTHERAPY.

(L. C. Card No. Mic 59-5350)

David DeWaller Blyth, Ph.D.
The Ohio State University, 1953

Psychotherapy was offered to one hundred ninety-three neuropsychiatric disability veterans who came to a Veteran's Administration medical unit for a pension examination. Although many of these veterans responded to the offer with clear-cut acceptance or rejection, many responded ambivalently. In the present study twenty-two variables involving the subjects personality and background were related to varying degrees of acceptance or rejection of treatment. Through the use of the Rotter Incomplete Sentence Blank, dependence and independence (as defined by Rockwell[1]) were scored by means of a manual constructed along the lines described by Dunlap.[2] A self-insight measurement was obtained through the use of the Gross Self-Insight Test somewhat modified for a wider intellectual range. Intelligence was measured by the Wechsler Bellevue Vocabulary Scale.

The clinicians who examined and offered treatment to the veterans were ranked according to the amount of their clinical experience. Other data concerning the veteran's personal history were obtained from personal interviews. These data were supplemented by examining his Claim File and Medical File.

Nine variables were found to be significantly related to the rejection-acceptance continuum. The following factors were related (in order of importance) to acceptance of treatment: greater dependence, lesser distance from the clinic, lesser independence, greater self-insight, older or intermediate (rather than a younger or only) child in terms of his ordinal position in the family, initial examination and treatment offer by a more experienced clinician, lesser job stability, broken home background and culturally approved marital status. Variables that were not significantly related to the rejection-acceptance continuum included: previous personal contact with a neuropsychiatric hospital, number of siblings, severity of diagnosis, amount of current pension, current salary, number of dependents, age, length of military service, amount of education, rank in service, combat experience, direction of change in amount of pension as a result of the last pension examination, and intelligence.

The group who accepted treatment were also compared with a group of regular clinic patients (new patients referred by local doctors or agencies, or patients who came on their own seeking treatment) on fifteen variables. They were differentiated on two variables—direction of change in pension as a result of the last examination, and length of service. Neither of these was found to be significantly related to the rejection-acceptance continuum. The regular clinic patients and the group who accepted treatment were not different in terms of the number of sessions of treatment in which they participated.

It is felt that the findings have considerable meaning for Veterans Administrations clinics in general and probably for neuropsychiatric patients of all kinds. One of the implications is that more neuropsychiatric patients might accept treatment if the offer of treatment was made consistent with the extent of their needs for dependence and independence. It is also possible that the effectiveness of different techniques of psychotherapy varies with the personalities of the patients undergoing treatment. Thus some techniques may be more useful with dependent patients, whereas others are more effective with independent patients. Microfilm $2.50; Xerox $7.40. 157 pages.

1. Rockwell, Anne Frogue. "The Evaluation of Six Social Learning Need Constructs," Doctoral dissertation, The Ohio State University, 1950.

2. Dunlap, Ralph A. "A Study of the Relationship of Dependency to the Seeking of Psychological Counseling in College Freshmen." Masters thesis, The Ohio State University, 1951.

Abstract published by special arrangement with The Ohio State University.

REACTION TIME AND INTENSITY OF RESPONSE AS A FUNCTION OF ANXIETY AND STRESS

(L. C. Card No. Mic 59-5544)

Carl Murray Cochrane, Ph.D.
The University of North Carolina, 1959

Supervisor: W. G. Dahlstrom, Ph.D.

The experiment was designed to yield information about changes in drive and response factors, during performance

tasks, as a function of anxiety level and instructional stress. The dependent variables were simple reaction time and the intensity of the reaction time response. The former was assumed to be influenced by both drive and habit factors, the latter to be a relatively pure measure of drive. Forty-five high and forty-five low anxiety subjects were selected (using a multiple criterion of the Taylor and Sarason anxiety scales) and, after practice trials, subgroups were given instructions structuring the task as "gathering normative data", "an IQ test", or "an IQ test" plus statements implying poor performance during the practice. Results were:

(1) Absolute reaction speed scores did not vary as a function of the independent variables. This was true also of speed scores with drive (intensity) held constant by means of analysis of covariance techniques. When individual differences were controlled, by holding practice scores constant with analysis of covariance, the speed scores were found to vary in the direction of a predicted interaction. High anxiety subjects were superior under low stress, but showed a decrement under increased stress, while low anxiety subjects improved. The "IQ" and "IQ plus failure" groups performed alike, showing approximately equal decrements or increments depending on their anxiety level.

(2) Drive (as interpreted from intensity scores) was found to be positively related to anxiety levels but did not vary as a function of instructional stress. There was a tendency towards this relationship under practice conditions but apparently the stimulus factor of being in the experiment-proper, or knowing the scores were being taken "for a purpose" was necessary to make the drive-anxiety relationship reach a significant reliability level.

(3) A correlational analysis yielded data which supports Welsh's interpretation of his "R" scale (from the MMPI) as measuring repressive or inhibitory tendencies. R was found to relate negatively to speed but was not related to intensity under most of the experimental conditions. It thus appeared that R was related to a defensive or inhibitory set in most of the experimental situations. Under the greatest stress (IQ plus failure) this relationship was broken down by what was interpreted to be a break-down of defenses with consequent drive release (R being positively related to intensity).

The results were discussed in terms of their relationships to theories of anxiety, stress, and performance, and their implications for further research. It was pointed out that the results:

(1) supplied another instance of establishing a conditional-definition of anxiety as a drive,

(2) challenged the assumption that drive varies as a function of laboratory stress procedures, but supported the hypothesis that different response or habit systems may be elicited in such situations.

(3) underscored the need for broad exploratory studies, including a wider range of personality variables, in order to ascertain the type and number of constructs which will be necessary if an adequate predictive theory relating anxiety, stress and performance is to be derived.

Microfilm $2.50; Xerox $6.80. 141 pages.

THE RELATION OF ANXIETY, SEX, AND INSTRUCTIONS TO PERFORMANCE AND VERBAL BEHAVIOR DURING ANAGRAM SOLUTION.

(L. C. Card No. Mic 59-5457)

Richard Lynn Crager, Ph.D.
University of Washington, 1959

Chairman: Irwin G. Sarason

This research was done to test certain aspects of a habit interpretation of anxiety, which states that anxiety scale scores reflect the tendency of subjects to emit interfering anxiety responses to threatening situations. The class of supposedly interfering anxiety responses specifically investigated in this research was personal negative statements, e.g., "I can't pass this test." The hypothesis of such a class has been used to account for a rather stable set of empirical results which have shown that high and low anxious subjects perform equally well on a task after low motivation instructions (e.g., reassurance), but under high motivation instructions (e.g., describing an actually difficult task as easy) high anxious subjects perform more poorly than low anxious subjects.

To test this hypothesis a 2x2x2 factorial design was constructed with the variables of high and low anxiety (Test Anxiety Scale), male and female subjects, and high and low motivation instructions. Eighty college students were asked to solve ten difficult anagrams while verbalizing aloud their solution process. Performance scores of cues and time necessary for solution were obtained as well as a tape recording of all verbalizations, including personal negative statements, of the subjects. Direct support for the hypothesis would involve obtaining an anxiety by instructions interaction for the performance measures as well as the same interaction for the number of personal negative statements emitted while solving the anagrams. Because of the lack of empirical data on the verbal behavior of high and low anxious male and female subjects under differential instructions, and because other habits may be related to performance measures, the verbal protocols were also scored for two methods of solution (verbalized words versus verbalized letters of the anagrams), number of personal pronouns, two traditional anxiety measures (number of connectives and incomplete sentences), and a total productivity score (connectives plus word count plus letter count).

No anxiety by instructions interaction was obtained for the performance measures. The exact test of the habit hypothesis was, therefore, not available. However, certain evidence specific to sex of subject did emerge that was in accord with the habit hypothesis. Performance for high and low anxious females was found to correlate with the emission of personal negative statements. Both high and low anxious males, however, performed as well as low anxious females, yet emitted as many personal negative statements as the poorest performing high anxious females. Other sex differences were obtained, females using more

letters, fewer words and personal pronouns than males. No differences were found for connectives, incomplete sentences and total productivity scores.

Refinements for the present study were discussed as well as suggestions for future research. It was concluded that the technique of talking aloud merits further use in research of this type. Concerning the hypothesis which instigated the experiment, it was concluded that even though a direct test did not materialize, the hypothesis was in part supported, and merits further study. Furthermore, and probably most important, sex of subject seems to be an important variable which needs more investigation both in relation to the habit hypothesis and in its own right. Microfilm $2.50; Xerox $3.00. 57 pages.

STYLE AND CONTENT IN PERSONALITY RIGIDITY

(L. C. Card No. Mic 59-4414)

Florence Diamond, Ph.D.
The Claremont Graduate School, 1958

This investigation deals with the concept of rigidity as a generalized personality factor. Evidence for its generality in personality structure was sought in rankings of style and of repressive methods of control, and in a measure of authoritarian attitude.

The Rorschach Inkblot Test, the Draw-a-Person (DAP), and the California F-Scale were administered to 56 screened police candidates as a part of a selection process. The Rorschach scores of this group were in substantial agreement with published findings on normative groups, their DAP's were at the level of skill reported for college freshmen, and their mean score on the F-Scale was 3.62.

Scores on the F-Scale were used to divide the subjects into eight groups of seven subjects each, in such a manner that within each group there was a range of F-Scale scores from high to low. The subjects of each group also received two independent rankings on each of four measures: coarctation as judged from a formal analysis of the Rorschach psychogram, repressive methods of control as judged from a content analysis of the Rorschach protocol, repressive methods of control as judged from the DAP, and rigidity of style as judged from the DAP. The rankings for style on the DAP were made by art historians. The other rankings were made by clinical psychologists. It is pointed out that Rorschach's method of determining basic personality structure has much in common with the method of style analysis introduced into art history by his contemporary, Wolfflin.

The rankings were randomly assembled into two blocks, each block containing one set of five rankings for each group. (The rankings based on the F-Scale were the same in both blocks.) A coefficient of concordance, W_c, was calculated for each set of rankings, and these were averaged within blocks by converting them into their chi-square equivalents. The result in each block led to rejection of the following basic null hypothesis (W_c's = .29 and .33; $P < .05$):

> The various aspects of rigidity as measured by five instruments: the F-Scale, Coarctation on the Rorschach Psychogram, Fluidity of Style on the DAP, Repressive Methods of Control on the Rorschach Protocol and Repressive Methods of Control on the DAP are independent and not significantly correlated with one another.

The relationships between the various measures were then assessed by Kendall's method for estimating the probability function for sets of rho's. Twenty-seven of 32 such relationships were positive, 12 being significant; none was significantly negative.

The results are interpreted as giving support to the theory of generalized rigidity. This finding does not contradict the fact that rigidity may also appear as a response to anxiety provoking situations. The small size of the obtained coefficients of concordance indicates the need for caution in clinical assessments of generalized rigidity.

Microfilm $2.50; Xerox $7.00. 150 pages.

RESPONSE SET OF PULMONARY TUBERCULOSIS PATIENTS

(L. C. Card No. Mic 59-5512)

Eugene Paul Engen, Ph.D.
Louisiana State University, 1959

Supervisor: Irwin A. Berg

Human responses frequently differ from chance expectancy in unstructured situations. These sets or modal responses are known to be stable and there appears to be a relationship between sets and personality characteristics; when those responses which deviate from the mode are used as personality measures the relationship is higher. Recent evidence has shown that various personality groups can be identified by the frequency and/or pattern of deviant responses in noncritical areas of behavior. It has not been shown, however, that persons afflicted with chronic physical disease, and known to display certain symptoms of disturbance, also will show deviant response patterns in an area of behavior not ordinarily considered symptomatic of personality deviation. The design of this investigation was the criterion group method, hence, relative response sets were investigated, with the group under study operationally defined as tuberculous. The affliction of these subjects with tuberculosis was verified. Set was defined as the predisposition of an individual to respond in a given direction in a relatively unstructured situation. Set was elicited by the Perceptual Reaction Test. The data for comparison with the tuberculous groups were obtained from earlier studies of response set. The frequency of responses of each group was tabulated for each of the options of the Perceptual Reaction Test. The difference in proportion of two groups selecting a particular option was tested for significance. A deviant response was defined as one which was significant at the one per cent level of confidence. The responses of the tuberculous groups were scored on several scales, and the differences in mean score between these groups and the cross-validation groups were tested for significance.

The tuberculous groups differed significantly from normal, schizophrenic, and adolescent groups in frequency

and/or pattern of deviant responses. Male patients of the "far advanced" stage of tuberculosis gave significantly more deviant responses than the "moderately advanced" group, and the former group appeared more disturbed. Similar significant differences were not found in the female tuberculous group. The tuberculous males defined as of "higher" occupational level and of more education gave significantly fewer deviant responses than those defined as of "lower" occupational level and of less education, respectively, and in this sense the latter groups appear more disturbed. No significant difference in frequency of deviant responses between the more educated and less educated tuberculous females were obtained. Tuberculous female subjects differed significantly from the schizophrenic, mixed abnormal, and psychotic cross-validation groups. Similarly, the male tuberculous subjects differed significantly from schizophrenic, character disorder and mixed abnormal cross-validation groups. Male tuberculous subjects did not differ significantly, however, from the male psychotic group in frequency and/or pattern of deviant responses. The tuberculous subjects did not differ significantly from the respective cross-validation groups of the masculinity-femininity scale.

Moderate negative correlations were obtained for the tendency of male tuberculous patients to respond in a schizophrenic manner and also as persons with a character disorder, and tendency to respond in the typically masculine manner in deviant response pattern. A lack of relationship was obtained for tendency of tuberculous female subjects to respond like a schizophrenic and to respond in a typically masculine manner in deviant response pattern.

Subjects of a known deviant personality group displayed deviant behavior in other than symptom areas. Thus, the response pattern of the tuberculous groups tended to be general as predicted from Berg's Deviation Hypothesis. Further evidence is given to this unifying principle for predicting behavior in one area from behavior in another area. Microfilm $2.50; Xerox $3.00. 49 pages.

AN EXPLORATORY STUDY OF THE COMPARATIVE PERFORMANCE OF NORMAL AND BRAIN-DAMAGED CHILDREN ON A SERIES OF DEVELOPMENTAL TASKS

(L. C. Card No. Mic 59-6481)

Sidney M. Glassman, Ph.D.
Purdue University, 1959

Major Professor: John M. Hadley

This study represents an exploratory investigation of the developmental consequences of brain damage in children. It was hypothesized that the performances of brain-injured children on developmental measures would be characterized by significant degrees of retardation and, further, that the performances on the various tasks would be significantly interrelated. Additional hypotheses were generated regarding the influence of specific etiological variables on the extent of developmental retardation.

The developmental measures used in this study were selected on the basis of their demonstrated capacity for assessing the maturational level of perceptual, gross motor, and visual-motor skills. These tests consisted of the Archimedes Spiral Aftereffect, portions of the Kraus-Weber Test for Minimum Muscular Fitness, and the Children's Perceptual Achievement Forms. The Wechsler Intelligence Scale for Children was also administered in order to explore the relationship between intellectual factors and performance on the developmental tasks.

Three groups of subjects were employed. The Comparison Group consisted of fifty children, between five and six years old, who presumably represented a normal population. The Experimental Group was comprised of twenty-three children, ranging in age from seven to seventeen years. They were drawn from an institution for mentally deficient children on the basis of rigid criteria for cerebral pathology. A small group of uninstitutionalized, brain-damaged children was also tested in order to determine the extent to which generalizations might be made from the findings on the Experimental Group. The test performances of each group were compared with the other groups and with the previously published norms on the developmental tasks.

The performances of the Experimental Group on all the developmental tests fell significantly below the norms for their chronological age. Older subjects performed more successfully than younger subjects. Only one of the tasks failed to correlate significantly with the other measures. In spite of a definite age advantage, the Experimental Group performed no better than the Comparison Group on any of the measures and did significantly less well on two of the measures. Similar results were obtained even when the groups were matched for mental age. These findings suggest that brain damage in children may result in a generalized retardation of development in addition to more specific and permanent defects. The level of this retardation appears to improve as the child grows older.

The influence of various etiological factors on the severity of retardation was investigated. Children having prenatal or paranatal injuries demonstrated greater impairment than those with postnatal injuries. Similarly, subjects with generalized cerebral lesions were more severely retarded than those with localized damage. Various types of injuries appeared to be closely related to the age of the child when damage was incurred, and consequently, the influence of the type of injury could not be independently assessed.

Inspection of the performances of the Outpatient Group suggested that although the severity of developmental retardation may vary greatly among children with cortical damage, the relationships observed between etiological factors and degree of impairment remain operative.

The implications and limitations of this study are discussed in regard to diagnosis, treatment, and further research. Microfilm $2.50; Xerox $4.40. 85 pages.

THE CONDITIONING OF VERBAL AFFECT RESPONSES IN TWO HOSPITALIZED SCHIZOPHRENIC DIAGNOSTIC GROUPS DURING THE CLINICAL INTERVIEW

(L. C. Card No. Mic 59-5450)

James Marshall Hagen, Ph.D.
State College of Washington, 1959

Supervisor: Dr. W. A. Cass

The purpose of the experiment was to test the hypothesis that schizophrenics classified as chronic undifferentiated tend to demonstrate a greater strength of conditioning of verbal affect responses than do schizophrenics classified as paranoid.

The experiment consisted of setting up a single clinical interview situation with individual subjects in which operationally defined verbal classes of affect responses (Types I, II, III, and IV) were reinforced by a simultaneous "mmm-hmm" and head nod by the interviewer. Type I verbal affect statements referred to any statement describing or evaluating the state (other than intellectual or physiological) of the patient by himself. Type II referred to statements primarily reflecting intellectual private events, to actions, and/or desires. Type III included statements reflecting a generalized feeling about the environmental surroundings or the position in which the subject finds himself. Type IV statements were defined as statements that were not direct expressions of the subject's affect but referred affect to the subject by another person. All interviews were tape-recorded with the recorder in full view of the subject.

Subjects were twenty white, male paranoid schizophrenics and twenty white, male chronic undifferentiated schizophrenics presently in a Veterans Administration neuropsychiatric hospital. After eleven clinical psychologists rated four variables for strength of conditionability, all subjects were coded and matched according to these variables. Ten matched subjects from each diagnostic group were randomly assigned to the experimental group and a comparable number of matched subjects were randomly assigned to the control group by means of a deep stratification matching process. The interviews lasted thirty-six minutes and were divided into three consecutive but unbroken periods of twelve minutes each. The experimental group received reinforcement during the second twelve-minute period, whereas all reinforcement was withheld from the controls. All interviews were recorded and a detailed analysis was made of the verbal affect responses given. Scoring reliabilities were handled by having two independent judges and the experimenter read the typed transcripts and score only those affective responses upon which there was common agreement. Statistical procedure used in analyzing the results was the analysis of variance.

Experimental results were as follows:

1. Results demonstrated, beyond the .01 level of confidence, that operant conditioning of verbal affect responses in a clinical interview situation occurred in both the chronic undifferentiated and paranoid schizophrenic groups when reinforced by a simple class of stimuli.
2. The hypothesis that schizophrenics diagnosed as chronic undifferentiated types demonstrate a greater degree of conditioning of total affect statements than schizophrenics diagnosed as paranoid types was not supported. Although the data had already been used in the analysis of variance computations, a "t" was calculated. The obtained "t" indicated significance at beyond the .02 level of confidence and supported the hypothesis.
3. The hypothesis that patients classified as chronic undifferentiated schizophrenics will tend to demonstrate a higher degree of conditioning of Type I, II, and III affect statements than those classified as paranoid schizophrenics was not substantiated. A trend in the predicted direction was shown for the Type I affect statement.
4. The hypothesis that patients classified as paranoid schizophrenics will tend to demonstrate a higher degree of conditioning of Type IV verbal affect statements than those classified as chronic undifferentiated schizophrenics was not substantiated.
5. Results indicated that several classes of verbal affect statements could be conditioned. Under reinforcement conditions, significant increases occurred in Type I, III, and IV verbal affect statements.

Psychotherapeutic and diagnostic implications for operant conditioning were discussed and further operant conditioning research was suggested.

Microfilm $2.50; Xerox $5.20. 104 pages.

THE EFFECTS OF BRAIN DAMAGE ON A TACTUAL-KINESTHETIC PERCEPTION TASK

(L. C. Card No. Mic 59-6201)

Albert Rayburn Jones, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor Leland E. Thune

A complex tactual-kinesthetic perception task was designed to measure the effects of brain damage, regardless of etiology, extent, or location, on performance involving several areas of behavior which have been identified as being sensitive to impairment due to organic brain dysfunction. The measurements were made in a single, individual testing session, and required the subject to perceive tactually the form of geometric designs which were presented in separate halves simultaneously, and later to recognize the related drawing from a visual multiple-choice recognition card.

Five sets of designs, each set containing five designs, were presented three times: the first two presentations were identical, the third presentation involved a right-left rotation of the stimulus figures. Three measures were made: the length of time the subject explored the stimulus design, the length of time he required to make his recognition response from the multiple-choice card, and the drawing he selected (which was scored as right or wrong).

Forty brain-damaged and forty non-brain-damaged patients of Veterans Administration hospitals were used. Each non-brain-damaged subject was matched with a brain-damaged subject on the basis of age (within two years)

and IQ (within four points). All control subjects were psychiatric patients.

The forty matched pairs of subjects were ranked by age and systematically assigned to two replication groups, with twenty pairs in each group. Analysis of data was done for each of the replication groups separately.

It was predicted that the brain-damaged subjects would make fewer correct choices from the visual recognition cards than would the non-brain-damaged subjects, that they would have longer time measures than would their control subjects, and that they would choose more rotated figures from the multiple-choice cards.

The total number of correct choices did not efficient differentiate the brain-damaged from the non-brain-damaged group. Neither did the time measures discriminate between the two groups. However, when the number of correct choices for parts of the task were weighted by response time measures, the two groups were differentiated at the .02 level of confidence (two-tailed test), and 70 per cent of all eighty subjects were correctly identified as being brain-damaged or non-brain-damaged. The number of rotated figures chosen from the visual recognition cards did not efficiently discriminate between groups.

It was concluded that with further revision, refinement, and standardization, a task of this nature might be a useful aid in diagnosing mild organic brain impairment. Suggestions for further research were made.

Microfilm $2.50; Xerox $4.80. 93 pages.

STRESS AS AN INDEPENDENT VARIABLE IN TRANSFER OF TRAINING

(L. C. Card No. Mic 59-6487)

Edwin Lloyd Krauser, Ph.D.
Purdue University, 1959

Major Professor: Mark W. Stephens

Six groups of 19 female undergraduate students each were employed to test the following hypothesis: Given a condition of stress under which subjects are to perform a task upon which they have previously been trained, the obtained level of performance will increase as the conditions under which they are trained become increasingly similar to this condition of stress.

A contrary hypothesis was generated to the effect that performance would vary as a function of degree of stress applied, rather than as a function of similarity of training and performance conditions. Additional hypotheses were tested to the effect that the number of subjects who chose memorization as an appropriate method of task solution would vary inversely with degree of stress to which they had been subjected, and that choice of memorization as the method of solution preferred would be related to a high level of performance in the absence of stress and a low level of performance in the presence of it.

The Coding subtest of the Flanagan Aptitude Classification Test, Form 2B was employed as the Criterion task. Subjects were trained to associate a code symbol (number, letter, or combination of numbers and letters) to each of 25 stimulus words, then given the stimulus and asked to pick the appropriate symbol from a series of symbols presented with it. Subjects were assigned to groups at random and equated for ability on this type of task. They were then trained for ten minutes on the criterion code under varying stress conditions and a two minute sample of their performance under these conditions taken. Following a rest period they were again tested, this time on a longer (seven minutes) but otherwise identical test.

The condition of stress under which most subjects performed on this latter test consisted of intermittent hammering noise ranging from 70 to 97 decibels in intensity. The conditions under which they were trained on the code varied in similarity to this condition. One group was trained under identical hammering noise, one under high intensity pure tones ranging from 500 to 6500 cycles per second and from 70 to 97.5 decibels, one under a non-auditory stress consisting of the threat of a hypodermic injection, and one under no stress at all. Two control groups were employed. One trained under stress and performed in the absence of it; the other was trained and performed in the absence of it.

Questionnaires indicated that the tones and hammering noises were perceived as stressful by most subjects, but the hypodermic threat was not. Despite the stressful nature of the working conditions there were no significant differences between groups on the criterion measure in either number of items completed correctly, number of items attempted, number of errors, or accuracy. Degree of variation in obtained scores did not vary as a function of the amount of stress applied. There was little or no correlation between a subject's ability on the criterion task and opinion of the experiment. There were no significant differences between groups in regard to method of solution chosen, and significantly better criterion scores did not accrue to subjects in a particular condition who chose a particular method.

Microfilm $2.50; Xerox $6.60. 136 pages.

EXPERIMENTAL MODIFICATION OF AWARENESS AND ACCURACY OF VISUAL DISCRIMINATION

(L. C. Card No. Mic 59-6494)

Robert Miller Martin, Ph.D.
Purdue University, 1959

Major Professor: John M. Hadley

This investigation was designed to test whether or not correct and/or incorrect knowledge of results of the accuracy of subliminal discrimination would modify the awareness and the accuracy of visual discrimination. Certain specific relationships were hypothesized, namely, that correct information concerning the accuracy of subliminal discriminations would increase awareness and accuracy of subliminal discrimination, and that incorrect information concerning the accuracy of subliminal discriminations would decrease awareness and accuracy of subliminal discrimination.

Sixty subjects, both male and female with ages ranging between fourteen and forty-three, were used to make up three groups of twenty, the subjects being assigned to a group on the basis of the order in which they volunteered. The task of the subjects, who were tested individually, was

to discriminate whether a vertical narrow black rod was to the right or to the left of the center of a horizontal bar of light which was fifty centimeters long and one centimeter in width. The stimulus material was eight and one-half feet from the subject. The rod varied randomly to the right and to the left of center of the bar of light. The distance of the rod from the center varied randomly from one to ten millimeters. Subjects rated their confidence in their discriminations "1" for no confidence, "2" for slight confidence, and "3" for high confidence. On Series 1 (100 discriminations) no information was given to the subjects as to the accuracy of their discriminations. On Series 2 (100 discriminations) Group I was given correct information concerning their subliminal discriminations (those on which they rated their confidence "1"); Group II was given incorrect information concerning their subliminal discriminations; and Group III was given no information. On Series III (100 discriminations) no information was given to the subjects.

The results indicate that correct information did not significantly increase awareness of discrimination, as measured by the number of "1" judgements. Incorrect information did not significantly decrease awareness of discrimination for the males but it did for the females. Correct information did significantly improve accuracy of discrimination and incorrect information did significantly decrease accuracy of discrimination.

The results were related to certain theoretical issues and the implications of the results for authoritarianism, individual differences and for psychopathology were discussed. Microfilm $2.50; Xerox $3.00. 61 pages.

PRELIMINARY STEPS IN THE CONSTRUCTION OF FACTOR SCALES FOR THE MMPI

(L. C. Card No. Mic 59-5467)

Hayden LeRoy Mees, Ph.D.
University of Washington, 1959

Chairman: Paul Horst

This study was concerned with some of the problems which were considered preliminary to the construction of factor scales for the MMPI. These problems were: A) finding the dimensionality of a selected set of MMPI items; B) determining the degree to which these dimensions were similar when the items were used with two very different populations of subjects; and C) investigating the relationship between the items and the dimensions. These problems pertain to the two essential criteria for adequate factor scales: invariance and psychological meaningfulness of the factors.

Data consisted of responses to 119 MMPI items and sex of the subject. The items were selected from the ten usual MMPI clinical scales; sex was treated as an item from the Mf Scale. Each scale, then, had 12 items. These were selected from items scored on only one MMPI scale wherever such items were available; where 12 such items were not available, the required additional items were selected from items scored on only one additional scale. The two groups of subjects each consisted of 150 males and 150 females. Group I subjects were clients of the University of Washington Counseling Center, and Group II subjects were neuropsychiatric patients at American Lake Veterans Administration Hospital and Western State Hospital.

Each 12-item scale was split into two scales which made a total of 20 split scales. These were intercorrelated independently for each group and factor analyzed by the principal axis method. Ten factors were extracted. Factor loadings were estimated by a least squares method for the 120 variables for each group. The factor loading matrices for the two groups were then normalized by rows and rotated so the comparable factor vectors in the two matrices would be maximally similar to each other. An index of similarity of the comparable factor vectors was derived for each pair of factors. The factors were identified by matching factor loadings in the two rotated factor matrices. A factor loading of .45 was arbitrarily defined as indicating a significantly high loading. Whenever an item had such a loading on the same factor in both matrices, it was said to have a pair of significant loadings on that factor.

Of the ten factors extracted the first three were reliable, highly similar in both groups, identifiable, and psychologically meaningful. The next four factors were of questionable reliability, moderately similar in both groups, not identifiable, and therefore indeterminate. The last three factors were considered to be primarily error of measurement or experimental artifact and were not similar in the two groups. Using the arbitrary standard for significance, 88 items had pairs of significant loadings on a single factor; 14 items had pairs on two factors; 3 items on three factors; and 15 items had no pairs of significant loadings. Factors were identified by the items having pairs of significant loadings on a single factor. Factor I had 54 such items; Factor II, 16; and Factor III, 8 items.

Factor I appeared to be a general complaint factor and seemed to be quite similar to the first factor described in several factor analyses of MMPI scales. This factor is generally described in terms of serious psychopathology and scoring high on this factor would involve admitting socially undesirable characteristics. Factor II seems to measure denial of aggressiveness and appears to be related to the second factor frequently found in factor analyses of MMPI scales. This factor may be thought of as a repressive factor. Factor III is clearly related to a feminine interest pattern and most closely resembles the Mf Scale of the MMPI. This factor has also been reported in previous factor analyses of MMPI scales, but not so consistently as the previous two factors.

In conclusion, the results are cited as evidence for the relative invariance and psychological meaningfulness of these three factors. The similarity to results of factor analyses of MMPI scales attest to the usefulness and adequacy of the methods used in this study. This approach has the additional advantage of providing information about the MMPI items which is directly applicable to the construction of factor scales from the MMPI.

Microfilm $2.50; Xerox $5.80. 120 pages.

THE RELATIONSHIP BETWEEN PERSONALITY TRAITS AND PREFERENCES FOR INSTRUCTIONAL METHODS

(L. C. Card No. Mic 59-5962)

Howard Roscoe Patterson, Ed.D.
North Texas State College, 1959

This study investigated the relationship between personality traits as measured by the Guilford-Zimmerman Temperament Survey and preference for lecture and group-oriented instructional methods. The investigation proposed to develop an experimental research instrument that would reliably indicate instructional method preference; and, to test whether significant differences exist between each of the Survey traits as related to student preference for lecture and group-oriented methods of instruction.

The Student Instructional Preference Scale was a fifty-five-item attitude scale. The scale was developed from student "likes" and "dislikes" for lecture and group-oriented methods of instruction.

A representative population of 300 college students was selected on the basis of their academic classification and was administered the SIPS. Subjects were selected and approximately matched on the basis of sex and class experience with lecture and group-oriented methods of instruction. Students who made the fifty lowest scores on the SIPS favored the lecture method and were designated as group "L". Students making the fifty highest scores on the SIPS favored group methods of instruction and were designated as group "G". The Survey was administered to both groups.

A critical analysis was made for the ten traits measured by the Survey between the "L" and "G" groups. Fisher's t was computed as a test of significant group differences between the mean scores for the sub-tests of the Survey.

From an interpretation of the data, the first hypothesis was sustained that it was possible to develop a reliable instrument that would differentiate students in their preference for methods of instruction. A reliability coefficient of .996 was established by the test-retest method.

The second hypothesis was partially sustained, that is, some significant differences were found between groups "L" and "G" subjects on personality traits as measured by the Survey. Traits G and S significantly differentiated group "L" and group "G" subjects at the 5 per cent level of significance or better; differences between groups "L" and "G" male subjects on trait A were significant at the 5 per cent level of confidence and favored group "G"; differences between groups "L" and "G" female subjects on trait F approached significance (p .06) and suggests tentatively that this trait might differentiate between group "G" and group "L" females, though this needs further study; differences in mean scores on trait E did not reach significance at the 5 per cent level (p .08) but favored group "G"; and the data further indicated that there was no significant difference between groups "L" and "G" on traits R, O, P, and M.

It can be concluded that group "L" demonstrated by their test scores a style of behavior that was characterized by an inhibited disposition and an over control of their impulses; that they appear lethargic in overt activity; and, that they appear less conventional in their social relations. Furthermore, there was a definite tendency for lecture-oriented subjects to appear socially withdrawn, to the extent that they are often-times described as being shy and submissive in social situations.

Group "G", as indicated by their scores, tend to be more active in their behavior, to manifest a higher level of vitality, to be more cheerful, and display greater emotional stability. Group "G" tends to be more objectively oriented, to show greater social conformity. And last, it was indicated that group-oriented subjects have a better understanding of their behavior in relation to others.

Microfilm $2.50; Xerox $4.80. 95 pages.

DEVELOPMENTAL AND BEHAVIORAL DIFFERENCES BETWEEN ESSENTIAL AND REACTIVE ALCOHOLICS

(L. C. Card No. Mic 59-5284)

Richard Ronken Rudie, Ph.D.
University of Houston, 1959

In recent years, a number of responsible people have attempted to convey the notion to the public that alcoholism is a disease. The salutary effect of this indoctrination has been a shift in public opinion toward regarding alcoholism as preventable and treatable. However, it is possible that this notion may turn out not to be true.

If alcoholism really is a disease, then the direction to be taken in theorizing and experimenting in this area would be to find the unique set of events--cause, onset, symptoms, course, and sequelae--which, when found, will define the disease. Most research in alcoholism has followed along this line of thought, and no disease entity has been isolated. Actually, the medical profession has found it expedient, in patient management, to fall back upon the quasi-religious controls of the AA program as its major resource in later stages of treatment.

An alternative view of problem drinking is to consider it as resulting from a number of complex patterns of learned needs, attitudes, habits, etc., acquired under varying causal conditions. Knight's conception of clear distinctiveness between "essential" and "reactive" alcoholism seems to be a step in this direction.

From clinical experience, Knight characterizes the essential alcoholic as emotionally dependent, egocentric, pleasure-seeking, irresponsible, insincere and unreliable; he is unable to establish or to maintain long term goals, or intimate, lasting relations with others. Knight's description of the characteristics of the reactive alcoholic is less specifically drawn; but the implication is that the reactive alcoholic, to one degree or another, possesses traits opposite to those listed for the essential group, and in addition is strongly compulsive. Knight infers that these differences in behavioral characteristics result from differences in psycho-sexual development in the early, formative years.

Knight also characterizes these two groups in terms of more concrete behavioral implications of this typological distinction. Thus, he refers to likely differences between the groups in terms of educational and occupational experiences, kinds of drinking and eating habits, time of onset of drinking, prognosis, etc.

This study was an attempt to discover group differences

between essential and reactive alcoholics in developmental experiences and in personality organization. Knight's description of the behavioral distinctions between the two groups served as a basis for developing a selector questionnaire as the criterion instrument. The other measuring techniques used were intended to obtain information of possible group differences in such areas as psychosexual development, strength of specific social needs, attitudes, conflict areas, range and intensity of defensive behavior, and developmental events (e.g., family experiences, interpersonal relations, etc.).

On the basis of Knight's clinical description of behavioral differences between the two alcoholic groups, and additional inferences drawn by the investigator, certain general expectancies were used as rough guides in the selection of predictor instruments and in the subsequent data analysis. The statement of formal hypotheses was regarded as more appropriate for a later cross-validation study. These general expectancies were as follows:

(1) Psychosexual development. As contrasted with the reactive group, the essential alcoholics possess traits associated with an earlier fixation in psychosexual development.

(2) Learned needs. The essential alcoholic's need system is predominantly oriented toward self-gratification and dependency upon others (e.g., greater strength of need for succorance, exhibitionism, change, heterosexuality). The reactive group's need system contains a relatively stronger degree of need for accomplishment, constancy, and for social responsibility (e.g., higher scores on achievement, order, nurturance, endurance).

(3) Defensive behavior. As contrasted with the essential group, the reactive alcoholics have a greater overall defensiveness; their defensive system is relatively complex and includes a relatively greater tendency toward intellectualization.

(4) Developmental experiences and other historical data. The essential alcoholic's family (orientation and procreation) background is one of strife, conflict, disloyalty, disunity, and disharmony within the family and of non-conformity with society and its institutional controls. All of this is less true of the family background of the reactive alcoholics.

The criterion group selector questionnaire was constructed in two preliminary studies. The test-retest reliability (r = .66) of this instrument was interpreted as adequate evidence of the stability of the instrument in view of the relatively extreme conditions employed.

The other testing instruments or techniques used in the study were: (a) the Frieda Goldman-Eisler Rating Scale, a self-report technique intended to provide information concerning character traits presumably associated with early psychosexual experiences; (b) the Edwards Personal Preference Schedule; (c) the Rorschach test; (d) a Sentence Completion test developed by Wiener, Carpenter, and Carpenter to measure defensive behavior; and (e) the Minnesota-Briggs History Questionnaire.

The subjects for this study were selected from a random sample of 188 alcoholic patients hospitalized at the Willmar State Hospital, Willmar, Minnesota. For most of the data analysis, the sample consisted of 20 essential and 16 reactive alcoholics, selected on the basis of having obtained scores that were more than one standard deviation above or below the mean on the selector questionnaire. For the analysis of the Briggs questionnaire data, this sample was increased to 58 by adding subjects who scored within the middle range on the criterion measure.

With the smaller sample (N = 36), there were no significant group differences in age, education, or test intelligence. The reactive alcoholics were significantly higher in educational level in the larger sample (N = 58).

The expectation of group differences in psychosexual development and in acquired needs was not fulfilled; there were a few scattered findings and "trends" which did not appear to merit interpretative effort. Instead, the conclusion was drawn that Knight's "theoretical" distinction between essential and reactive alcoholism probably should not be faulted on the basis of these essentially negative findings, because of the uncertain validities of the Goldman-Eisler and Edwards scales. However, as pointed out, those aspects of Knight's theory asserting group differences in the actual events of psychosexual development in the infancy period are not absolutely crucial to other aspects of his theory concerning group differences in other conditions and phases of development.

Similarly, no significant findings were obtained from the Rorschach theme analysis using Schafer's system of scoring content for psychosexual development. Because of the small incidence of scorable content responses in this study, it was concluded that this system of analysis would probably be workable only with cases showing a greater degree of behavior pathology.

The judgments of defensive choice from Rorschach protocols indicated a significant group difference in the use of denial, with the reactive group more frequently choosing this relatively complex form of defense. There was also a tendency, which was not statistically significant, for the essential alcoholics to choose more frequently the relatively simple defensive tactic--repression.

Some consideration was given to several unexpected findings in the judgment of Rorschach defensiveness. It was concluded that the relatively high proportion of projective defenders and low proportion of intellectualizing defenders among the total sample of this study, as compared with corresponding distributions in previous studies, was probably a function of the lower socio-economic status of the present group. This judgment was based upon previous research findings.

The relatively slight group distinctiveness in the use of projective defenses in the Rorschach situation led to a re-examination of Schafer's criteria for judgment of this defense. It was found that Schafer distinguishes two clear subclasses of criteria for projection which correspond with the impressions of the examiner of behavioral differences shown by the groups during the testing situation. While these observations cannot be interpreted as findings in the present study, they do lead to questions which quite possibly are testable. These questions concern possible qualitative differences in defensiveness between normal and behaviorally disturbed populations, and differences in the conditions determining specific kinds of delusional systems.

The lack of comparability in the results of the Rorschach and Sentence Completion data analysis of defensive behavior was interpreted in terms of possible differences

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

in response requirements for the two situations. These differences were seen as possibly associated with differences in degrees of awareness in the subjects of the implications of their test behavior to the examiner. This interpretation leads to two possible questions for further empirical inquiry. One concerns possible individual differences in defensive patterns under varying degrees of awareness on the part of the individual of the implications of his behavior to others. The other, broader, experimental question concerns the specificity vs. generality of defensive systems in the individual personality. Other possible experimental variables in research on defensiveness are degree of threat and type of conflict.

A good proportion of the significant results of this study were expected on the basis of Knight's clinical observations. The classes of expectancies that were, in good part, confirmed concerned group differences in defensive behavior, and in developmental experiences and other historical data.

The findings with the Sentence Completion test indicate that the reactive alcoholic group has a much more pervasive defensive system than the essential alcoholics. This generalization continues to apply whether the analysis is by separate defense or by separate conflict area, and is particularly applicable to the use of the more exacting tactic, intellectualization. It was also apparent that the reactive group has a stronger tendency to use specific defenses to cope with specific types of conflict, while the essential alcoholics characteristically do not defend or, if they do, they do so with a simpler, more generalized defensive system.

In the cluster analysis of the Minnesota-Briggs History Questionnaire, it was found that the essential alcoholics were significantly higher than the reactive alcoholics on the psychopathic, conflict with parents, unstable-unrewarding home, sibling conflict, lability of feeling and emotion, and patient's hedonism clusters. The essential alcoholics were significantly lower than the reactive alcoholics on the achievement, patient's educational accomplishment, and patient's occupational accomplishment clusters.

Thus, Knight's distinction between these alcoholic groups appears to be an essentially valid and useful one, which will serve to reduce variance in future research in alcoholism. This tentative conclusion will be tested further with studies of predictive validity and cross-validation of the present findings.

Microfilm $2.50; Xerox $8.60. 186 pages.

ACCURACY OF PSYCHOMOTOR PERFORMANCE AS A FUNCTION OF INSTRUCTIONS, EXPRESSION-REPRESSION, AND ANXIETY.

(L. C. Card No. Mic 59-6447)

George DeWitt Sauté, Ph.D.
The University of North Carolina, 1959

Supervisor: W. Grant Dahlstrom

This experiment was designed to gain further understanding of the behavioral characteristics measured by the Anxiety (A) and Repression (R) personality scales developed by Welsh from the MMPI. Primary emphasis was placed on comparing three interpretations of the R dimension: repression, inhibition and compliance. The experimental subjects were selected by both A and R scores in order to provide concurrent information on the influence of R in the behavioral manifestations of anxiety as well as a comparison of the different types of stress on the performance of subjects differing in A score.

Sixteen subjects in each of the four quadrants formed by the A and R scales were selected on the basis of extreme scores on both scales from 391 ROTC students. The experimental task consisted of firing a trigger when a silhouette of an airplane designated enemy (positive stimulus) was presented on a projection screen and making no response when any of four silhouettes designated friendly (negative stimuli) appeared. Subjects were told that the task had military significance and that the ability to do well was highly related to intelligence.

Four blocks of 35 trials were administered; in each block of trials the positive stimulus was presented 23 times and the four negative stimuli were each presented three times. After the first block of trials, each S was told that his performance had been far inferior to that of his peers. Half the subjects in each A-R quadrant were told that their primary mistake was in responding too slowly to the positive stimulus; the other subjects were told that they erred primarily in firing too frequently at the negative stimuli. After another block of trials, subjects were told that they had over-compensated for the main error they had been making previously and should now try to reduce the other type of error. Preceding the last block of trials, all subjects were told that they would receive an electric shock after making several errors of the type earlier referred to as their primary error. Subsequent to the experiment, subjects were told of the deception, reassured and asked a series of questions about their reactions to the experimental procedures.

The number and amplitude of responses to the various stimuli were computed for each S. The two sequences of instructions significantly affected the frequency of response to the negative stimuli but not the amplitude of response. There were no significant differences in any dependent measure between the high and low groups on either A or R. Nor were there any significant interactions between A and R in the ways expected prior to the experiment. Hence the results of the experiment failed to confirm any of the interpretations of the A and R scales which were subjected to test.

Microfilm $2.50; Xerox $6.00. 121 pages.

THE RELATION OF EGO CONTROL TO OVERT AND FANTASY AGGRESSION

(L. C. Card No. Mic 59-6319)

Morton Silverman, Ph.D.
Syracuse University, 1959

Supervisor: Joseph Masling

The purpose of this study was to examine the role of ego control variables in determining the relationship between children's overt and fantasy expressions of their aggressive needs. The following hypotheses were tested:

1. Emotionally disturbed children will demonstrate greater consistency in their overt and fantasy expressions of aggression than will normal children.
2. Among non-disturbed children:
   A. Children demonstrating strong ego controls, who are rated as overtly aggressive, will obtain lower fantasy aggression scores than children demonstrating strong ego controls who are rated low in overt aggression.
   B. Children demonstrating weak ego controls, who are rated as overtly aggressive, will obtain higher fantasy aggression scores than children demonstrating weak ego controls who are rated as low in overt aggression.

Twenty inpatients at a psychiatric hospital for children constituted the emotionally distrubed group. Sixty boys, attending a Rhode Island public school, constituted the normal group.

Teachers' ratings of the overt behavior of their students provided measures of overt aggression.

Fantasy aggression scores were derived from the Ss' responses to five TAT cards and five story completion stems. The fantasy productions were scored for the quantity of aggression expressed by a count of the aggressive incidents (fighting, lying, quarreling, etc.). In addition, each aggressive incident was scored in one of five qualitative categories (strong, subdued, self directed, etc.). The number of words used in each story was counted. These procedures yielded a total of twelve fantasy aggression scores for each S.

Two experimental measures of ego control were employed. With one, the child's ability to postpone an immediate reward for a later reward provided a measure of delay of gratification. With the second, the child's ability to persist at a task after satiation provided a measure of frustration tolerance.

To test the first hypothesis, Pearson product-moment correlations between overt and fantasy aggression scores were computed for both the disturbed and normal groups. The one statistically significant and one near-significant finding obtained indicated a lesser degree of positive association between overt and fantasy aggression in the disturbed than normal group. There was reason to believe that there was little difference between the findings obtained with the two groups, with no evidence suggesting more positive association between overt and fantasy aggression in the disturbed group. The second hypothesis was tested by means of chi-square analyses of the association between overt and fantasy aggression among the normal children of strong and weak ego control. Tests of the first half of the second hypothesis were statistically significant in four out of twelve instances but none of the tests of the second half of the hypothesis attained statistical significance. In each case of a statistically significant association between overt and fantasy aggression with strong ego control Ss, the association was in the direction predicted. The one near-significant association obtained with weak ego control Ss was also in the predicted direction. In all statistical analyses, verbal productivity was found to exert an important influence on fantasy aggression scores. The findings pertinent to the first hypothesis suggested that there may be many, rather than one, relationship between overt and covert aggressive behavior. The findings pointed to the need for more precise measures of fantasy aggression, particularly in relation to verbal productivity, and more refined definitions of experimental populations. The results obtained in tests of the second hypothesis were interpreted as lending some support to the contention that ego control variables influence the relationship between overt and covert expressions of aggression. They were felt to be encouraging enough to warrant further investigation with more sophisticated ego control measures.

Microfilm $2.50; Xerox $6.60. 137 pages.

A DEVELOPMENTAL STUDY OF INNER VS. EXTERNAL SPEECH IN NORMALS AND SCHIZOPHRENICS.

(L. C. Card No. Mic 59-6194)

Howard Joseph Slepian, Ph.D.
Clark University, 1959

Supervisor: Heinz Werner

The study concerns a developmental analysis of speech behavior occurring in a task of describing stimuli both to oneself and to others. More specifically, the inquiry was directed towards exploring differences in certain formal characteristics of linguistic behavior with regard to the following principal variables: (1) developmental level of the subjects, viz., normal vs. schizophrenic; (2) conditions of communication, viz., external speech vs. inner speech; and (3) degree of articulation of stimuli, viz., visual vs. olfactory, and visual articulate vs. visual diffuse.

The descriptions of visual articulate, visual diffuse, and olfactory stimuli, produced under conditions of inner speech and external speech by a group of normal and a group of schizophrenic subjects, were analyzed. Five indices regarding formal aspects of these linguistic productions were devised; these indices are assumed to provide different measures of the genetic level of the responses.

The findings pertaining to these indices may be briefly summarized as follows:

1. Schizophrenic language was found to be developmentally lower than that of normals throughout. Furthermore, the differences between the two groups tended to be greater under conditions of external vs. inner speech, and with regard to visual as compared with olfactory stimuli.
2. In general, the conditions of inner speech compared with external speech were associated with a genetically lower level of linguistic function; further, this difference was less evident when the subjects (viz., schizophrenics) were presumably more primitive, and when the stimuli (viz., olfactory) were such as would presumably promote more primitive behavior.
3. In general, responses to the olfactory stimuli were found to be more primitive than were responses to the visual stimuli; further, the differences between responses to olfactory and visual stimuli were less marked in schizophrenics than in normals, and less marked with inner speech than with external speech.

In the light of these findings, the following general theses are asserted:

1. Communication to the self (inner speech)

characteristically takes place at a lower level of linguistic functioning than communication to others.

2. The other-directed communication of schizophrenics is, in terms of developmental level of linguistic functioning, closer to that of self-directed communication of normals. In other words, in describing a stimulus object, schizophrenics tend, more than normals, to communicate to others at a level of linguistic behavior less differentiated from that involved in inner speech.

3. The task of describing olfactory stimulus-objects evokes a more primitive level of linguistic functioning than does the task of describing visual stimulus-objects.

In sum, it may be concluded that schizophrenics, as contrasted with normals, show a greater primitivity (i.e., greater syncretism, diffuseness, rigidity, and lack of subordination) of linguistic behavior in communication situations involving descriptions of stimuli. In consequence, they show a lesser degree of differentiation of speech behavior in regard to conditions of communication (inner vs. external speech) and in regard to types of stimuli. Microfilm $2.50; Xerox $7.60. 162 pages.

A STUDY OF THE MICROGENESIS OF PERCEPTS IN BRAIN-INJURED AND NORMAL ADULTS

(L. C. Card No. Mic 59-6195)

Kayla Jaffe Springer, Ph.D.
Clark University, 1959

Supervisor: Heinz Werner

This study investigates aspects of pathological as contrasted with normal perceptual functioning. The comparative-developmental approach of Werner (21) was employed. Attention was focused on the perceptual organization of a stimulus-configuration as a function of increasing exposure time.

Two groups of subjects were used, one with cerebral cortex damage, and one without. Each group consisted of 15 adult males matched for age, education, occupational level, and estimated I.Q. The subject's task was to respond, verbally and graphically, to each stimulus-configuration presented at progressively longer exposure times. The stimulus-configurations were sketches of objects differing in degree of figural complexity.

The expectations were that: (a) both groups would show a pattern of developmental progression in organization; and (b) the brain-injured would not use the increase in exposure time as adequately as normals for attaining specific levels of differentiation and integration.

Two major analyses were made: (a) overall findings as to conformity of tachistoscopic changes to the principle of developmental progression; and (b) group differences with regard to: (i) achievement of certain perceptual thresholds; and (ii) underlying processes--represented by qualitative aspects of changes in perceptual organization with increasing exposure times.

(a) Overall findings. Analysis of changes in percept structure with increasing exposure time indicated that, for the most part, the direction of change for both groups was from diffuse, to articulated, to integrated percepts. This finding allows us to view changes of percept organization in time as developmental in nature.

During progress from diffuse to integrated percepts, there were occasional reversals of direction towards lesser differentiation and integration, suggesting that the microgenetic sequence involves some developmental regression as well as a dominant progression.

(b) Group differences. Comparison of the two groups at an early phase (beginning articulation of the stimulus-configuration), and on two aspects of the final phase (recognition of content and spatial orientation), indicated that for most of the slides the brain-injured group required significantly more exposures to reach a given level of perceptual organization than did the normal.

Significant differences between the two groups appeared with regard to the frequency of occurrence at increasing exposure times of indices of primitive perceptual organization. With regard to primitivity of the individual percept, the brain-injured group had a higher frequency of assimilated, symmetrized, dynamized, and concretized percepts. This group was also significantly slower in the rate at which these primitive responses dropped out as the exposure times increased.

Significant differences also appeared regarding relations between successive percepts. Analysis in terms of regression indicated that, while the total frequency did not discriminate between the two groups, responses preceding the regressive ones were, among the brain-injured, more highly structured than were those preceding regression among the normals.

While no significant differences occurred in the number of times a specific content was repeated, the brain-injured tended to repeat previous whole responses, while normals tended to repeat responses to only part of the picture while changing other parts.

The brain-injured group was significantly more labile than the normal. Further, they more often tended to shift focus from one part of the picture to another, with a concomitant tendency to lose the articulation of one part while focusing attention on another.

These results offered evidence in accord with the expectations. Thus, although the direction of development is the same for both brain-injured and normal individuals, they differ in their ability to reach a satisfactory end-phase. The brain-injured individual does not seem to utilize the increase in exposure time as adequately as does the normal, for increasing differentiation and integration. The "normal" microgenetic process observed in the control group seems, in the brain-injured group, to be interfered with by a trend towards stabilization and specification at relatively immature stages of development. Microfilm $2.50; Xerox $5.40. 107 pages.

A STUDY OF SOME COMMUNICABLE MEASURES FOR THE EVALUATION OF HUMAN FIGURE DRAWINGS

(L. C. Card No. Mic 59-6520)

Deodandus Johann Willhelm Strümpfer, Ph.D.
Purdue University, 1959

Major Professor: Robert C. Nichols

The measures employed in this study were: the Albee-Hamlin Adjustment Scale, the Swenson Sexual Differentiation

Scale, the Lorge-Dunn Maturity Scale, the Wagner-Schubert Quality Scale, a newly constructed Aggression Scale, the Fisher Body Image Disturbance Scale, scores on the Person section of the Buck Quantitative Scale for the House-Tree-Person Test, and height and time relationships.

The objectives of the study were to determine, (1) the reliability of these measures, (2) the degree to which psychologists and a non-psychologist could agree in their use of the scales, (3) the psychological meaning of the measures, by means of item-analyses on the California Psychological Inventory, (4) the relationship between artistic quality and the other measures, and (5) whether these measures are related to broad levels of personal adjustment.

The subjects were two groups of, respectively, 107 and 50 male college students, as well as a group of male veterans, including 30 medical and surgical patients as normal controls, and 30 neurotic and 30 schizophrenic patients. Doctoral students in clinical psychology served as judges.

Satisfactory reliability for group predictions was demonstrated for the majority of the scales. In some instances the coefficients were high enough to justify individual predictions by a single judge. Psychologists and the non-psychologist were found to agree to a substantial extent.

Among 16 item-analyses on the psychological inventory, with the upper and lower groups selected on the basis of ratings or scores on each of the drawing measures, only one measure showed a significant number of the items to be related to it after cross-validation. This was interpreted as indicative of questionable validity for the drawing measures, since the self-appraisal items have previously been shown to be related to personality characteristics.

Highly significant correlations were found between the Quality Scale and the other drawing scales. It was concluded that psychologists are influenced to a significant extent by the artistic merit of the drawings when they are supposedly evaluating the drawings in terms of personality factors

Analyses of variance on the data of the normal, neurotic and schizophrenic groups failed to show significant differences between the means or variances of the three groups on any of the measures. Thus these measures failed to show relationship to such broad levels of adjustment and they were considered as of highly doubtful validity for the diagnosis of personality disorders.

Microfilm $2.50; Xerox $6.20. 126 pages.

CERTAIN RELATIONSHIPS BETWEEN PSYCHOTHERAPISTS' ATTITUDES AND THEIR PERCEPTIONS OF PATIENT VARIABLES

(L. C. Card No. Mic 59-6453)

Martin Wallach, Ph.D.
The University of North Carolina, 1959

Supervisor: Hans H. Strupp

This investigation represented an attempt to shed further light on attitudes of psychotherapists towards patients showing varying degrees of motivation for therapy, and to relate attitudinal facotrs in the therapist to the nature of his clinical evaluations. Two major hypotheses were formulated: 1) The more highly motivated patient will engender in the therapist a "warmer" attitude. 2) A "warmer" therapist attitude toward the patient is associated with a perception of the patient as being better adjusted, and with treatment plans which are in the direction of closer contact with the patient.

Two case histories of neurotic patients were adapted for experimental purposes. Each case history consisted of alternate forms which were identical in all respects, except that one form presented the patient as highly motivated for therapy and the other as poorly motivated. Each case history was followed by an identical questionnaire (27 items) eliciting the respondents' clinical impressions, treatment plans and attitudes toward the patient. Subjects were presented with the case histories of both patients, the degree of motivation being varied systematically.

Of 300 medical psychotherapists actively engaged in the practice of psychotherapy who were asked to participate, 82 completed and returned the material. Comparable analyses were performed for both cases, and included five major statistical comparisons and a more subjective evaluation of each respondent's responses for each patient.

Analysis of biographical data supplied by respondents indicated that the sample was drawn from a relatively homogeneous universe of experienced medical psychotherapists, and that they were equally distributed among various sub-samples. The majority of item comparisons which did not attain the customary levels of statistical significance showed trends in the predicted direction.

The following major results were obtained: Apparently quite independent of other patient variables, therapists with warm attitudes toward patients tend to describe the patients as possessing more insight into their problems and as having a better prognosis with treatment. These therapists claim greater ease in empathizing with the patient and express a greater willingness to accept the patient for treatment. Therapists who develop a warm attitude toward more disturbed patients are also inclined to posit a diagnosis of less severity and/or one that is less tinged with social disapproval; they are more apt to estimate a better prognosis without treatment. In addition to those factors shown to be applicable to both patients, therapists who develop a warm attitude toward the objectively less disturbed patient are inclined to estimate the patient's social adjustment as being more adequate, and the patient's motivation for therapy as being greater. With regard to the first hypothesis, it seems that therapists are more apt to develop warmer attitudes toward patients who exhibit mild disturbances and are well motivated for therapy.

On the basis of the findings of this study and other investigations, it was suggested that therapist selection procedures, therapist training and therapists' attempts to better understand the treatment situation should place greater emphasis upon the recognition and significance of therapists' attitudes toward patients. These statements followed from the basic belief that the therapist's attitude is an integral part of his technique and is closely related to his clinical evaluations and subsequent therapeutic operations.

Recommendations for future research included continued exploration of the relatedness of the therapist's attitude to other variables, a search for clarity in the description of relevant variables, and an investigation of the origins and effects of the patient's attitude toward the therapist. It was stated that the therapeutic process has been shown to be subject to experimental study, and that the

task remains to formulate relevant problems and to devise better tools which will provide pertinent answers.

Microfilm $2.50; Xerox $5.60. 112 pages.

CORRELATES OF RORSCHACH SHADING SCORES OBTAINED WITH TWO METHODS OF INQUIRY

(L. C. Card No. Mic 59-5591)

Patricia Fossum Waller, Ph.D.
The University of North Carolina, 1959

Supervisor: Emmett Earl Baughman

This study was designed to investigate the relationship between the shading response on the Rorschach and other indices of anxiety that are used in the clinic, and how these relationships may be affected by the use of a paired comparison inquiry procedure. The subjects were 82 psychiatric patients from three different hospitals. Each subject was interviewed and rated on a scale of overt signs of anxiety. All subjects were administered a series of tests, including the vocabulary and word fluency subtests from Thurstone's Primary Mental Abilities, the L, K, Welsh A and R, and Taylor A scales from the MMPI, the flexibility scale from the California Personality Inventory, and the Rorschach. Some subjects received the Baughman paired comparison inquiry procedure on the Rorschach, and others received the regular inquiry followed by the Baughman paired comparison inquiry.

Results indicated that shading scores on the Rorschach are a function of the inquiry procedure, and the Baughman paired comparison inquiry elicits a significantly greater number of shading responses than does the regular inquiry. The differences between shading scores on the regular inquiry and shading scores on the paired comparison inquiry are greater for a psychiatric population than for a non-psychiatric population. Furthermore, on the basis of shading scores the paired comparison inquiry differentiates between psychiatric and non-psychiatric populations significantly better than does the regular inquiry. The paired comparison inquiry appeared to be an easier procedure for psychiatric subjects than was the regular inquiry. A possible explanation was discussed, namely that the paired comparison inquiry consists of easier questions and hence results in more "successes" for the subject, as opposed to the many "failures" subjects appeared to experience when they in effect answered No to the question on the regular inquiry concerning further determinants of a response.

The paired comparison inquiry is not affected significantly by previous inquiry experience, i.e. the regular Rorschach inquiry preceding the paired comparison inquiry does not affect the results of the latter. Although the paired comparison inquiry renders a greater number and a greater dispersion of shading scores than does the regular inquiry, neither inquiry showed significant correlations with the Welsh A and Taylor A scales, an over-all clinical impression of anxiety, or a total count of clinical signs of anxiety. The presence or absence of texture responses showed a significant relationship to the clinical impression of over-all anxiety. This relationship held for both inquiry procedures.

An index of change based on the relationship of shading scores on the regular inquiry to shading scores on the paired comparison inquiry, showed no significant relationships to personality variables such as intelligence (vocabulary subtest from the PMA), word fluency (subtest from the PMA), and defensiveness (L, K, and Welsh R scales from the MMPI). Shading scores on the regular inquiry are more closely related to intelligence (as measured by vocabulary subtest from the PMA), than are shading scores on the paired comparison inquiry.

Some possible interpretations of the data were discussed. Microfilm $2.50; Xerox $4.20. 79 pages.

PSYCHOLOGY, EXPERIMENTAL

SOME BASIC ASPECTS OF SOCIAL REINFORCEMENTS IN ALBINO RATS

(L. C. Card No. Mic 59-5679)

Wilhelm F. Angermeier, Ph.D.
University of Georgia, 1959

Supervisor: Dr. William T. James

Many studies have concerned themselves with the influence of consummatory reinforcement upon behavior. This study was designed to measure the social reinforcement value of one albino rat for another with respect to the role which social deprivation, sex differences, and degree of physical contact play in this behavior.

METHOD

One female and 25 male Wistar rats of the Red Bank, New Jersey strain were randomly selected from five litters. Twelve male rats were reared in isolation. They were not allowed visual or physical contact with other animals during the time between weaning and the age of 120 to 150 days. Twelve other male rats were reared in one cage during an identical period of time.

All animals of the socially isolated group were divided into six equal subgroups and given the opportunity to receive social reinforcement upon pressing a bar in a modified Skinner Box. Subgroup I could see a male rat after pressing the bar, II could see a female rat, III could partially contact a male rat, IV was given partial physical contact with a female rat. Subgroup V was permitted full physical contact with a male rat, VI was allowed full physical contact with a female rat. The animals of the group reared together were treated in an identical fashion. After operant level determination, a total of twenty 1-hour daily trials were administered to all animals. The reinforcement during these trials was continuous and available for 10 seconds following each bar-press. These sessions were followed by two 1-hour daily extinction sessions.

RESULTS AND CONCLUSIONS

Rearing

All animals in the group reared together learned the response. In the group reared apart, learning increased

from 25 to 75 to 100 per cent directly with the degrees of physical contact permitted to act as reinforcement.

A simple t test showed significantly more learning for the group reared together than for the group reared apart (t was 2.20 for 22 dfs).

A factorial analysis of variance design revealed that in the vast majority of the cases, response frequency was higher in the group reared together (F was 9.45 for 1 and 12 dfs).

In the group reared apart, persistency increased with the degrees of physical contact during acquisition and extinction trials. In the group reared together, rate decreased with the amount of physical contact during the acquisition trials.

Sex

No important quantitative differences, dependent upon sex of the social stimulus animal, could be detected.

Degrees of Physical Contact

The influence of the degree of physical contact made available to the animals as social reinforcement was apparent only in the group reared apart. Here, a statistically significant F of 7.59 for 5 and 12 dfs was obtained for the interaction effect of rearing and degrees of contact.

It was concluded from the data that the involvement of tactile and visual receptors, both during rearing and learning, created a favorable condition for the effectiveness of social reinforcement.

Implications for further research were made.

Microfilm $2.50; Xerox $4.60. 87 pages.

THE ROLE OF CONSUMMATORY TIME AND DELAY OF REINFORCEMENT IN THE ACQUISITION AND PERFORMANCE OF A LINEAR MAZE HABIT

(L. C. Card No. Mic 59-6947)

Guido A. Barrientos, Ph.D.
University of Kansas, 1959

Seventy-two rats, divided into six groups of 12 each, were trained for 54 days under different combinations of delay of reward and consummatory time. The experiment consisted essentially of two replications of a 3 x 2 factorial design with three magnitudes of delay (0-sec., 15-sec. and 90-sec.) and two of consummatory time (50-sec. vs. 105-sec.). The animals were kept under a constant 22-hr thirst schedule. All Ss were rewarded with the same amount of water (2 ml.) and the differences in consummatory time were obtained by having Ss drink from tubes differing in diameter. The combinations of the above variables for each of the experimental groups were: A: 0-50; B: 15-50; C: 90-50; D: 0-105; E: 15-105; F: 90-105.

The apparatus was a modified Hill four-unit linear maze in which the same pattern of the "correct-path" was used for all Ss. The training period consisted of 54 days of one trial per day for each S. The animals were delayed for the assigned time in a delay compartment preceding the goal box. During training two behavioral indices were recorded: number of errors and running times. Ss in each group were trained until they had apparently reached an asymptotic limit of speed of response. On day 55 of training the Ss in each of the groups were shifted to new experimental conditions. Two animals in each group were tested under the conditions for the other five groups and two were kept as controls under the same conditions as in acquisition. For example, of the 12 Ss in group A two animals were shifted to the conditions for group B; two Ss to the conditions for group C, and so on. In addition, two rats were maintained under the same conditions as in training.

The results showed: (1) an inverse relationship between delay of reward and speed of response. At the end of training significantly different asymptotes of speed were achieved by each of the delay groups; (2) significant differences in speed of response between Ss rewarded with different consummatory times, the 50-sec. animals running faster than the 105-sec. animals; (3) a significant interaction, in running times during training, between delay of reinforcement and consummatory time; (4) no significant differences in the total number of errors during training associated with differences in consummatory time. On the other hand differences in the total number of errors during training were found between the delay groups, but some statistical reservations placed on these data made this finding questionable; (5) during the shifted-conditions period the only significant effects upon speed of response were due to delay of reward during the shifted-period and consummatory time during the shifted-period. In other words, these variables showed no "carry-over" effects from training unto the shifted conditions period; (6) significant shifts in speed of response followed shifts in delay, the direction of the changes being toward an acceleration of speed after a decrease in delay and a decrease in speed subsequent to an increase in delay. No contrast effects were found with reversals in delay; (7) since no errors were recorded during the shifted-conditions period, the experimental variables had no differential effects upon learning in this period.

The results were interpreted according to Spence's theory of incentive motivation. The analysis of variance for the data during the shifted-conditions period suggested that delay of reward and consummatory time do not affect habit strength but rather act upon excitatory potential.

Microfilm $2.50; Xerox $6.00. 122 pages.

THE INTERRELATIONSHIPS OF LEVELS OF EARLY TRAUMA AND CRITICAL PERIODS AS THEY AFFECT ADULT LEARNING AND EMOTIONALITY

(L. C. Card No. Mic 59-6467)

Robert Wayne Bell, Ph.D.
Purdue University, 1959

Major Professor: Victor H. Denenberg

The present experiment investigated the effects of infantile stress as it interacts with critical periods of development and adult stress and affects emotionality and avoidance learning.

Two hundred and ninety C57BL/10 mice served as

subjects. The infantile stress imposed upon the subjects consisted of handling or handling plus shock, with three intensities of shock, .1, .3, or .5 ma., being used. This stress was administered at either 2-3, 8-9, or 15-16 days of age, these ages being selected so as to correspond to the midpoint of the three pre-weaning critical periods in the development of the mouse (Williams and Scott, 1953). Non-handled control groups were also included. During the measurement of emotionality and avoidance conditioning, commencing at 60 days of age, one of three levels of shock, .3, .5, or .7 ma., was used as the unconditioned stimulus.

Complex interactions between amount of infantile stress, critical periods, and intensity of adult shock were found to exist for both emotionality and avoidance conditioning. The results suggest that the infantile stress does not affect emotionality prior to the administration of stress during adult life, but has marked effects subsequent to the administration of stress during adulthood. Directly opposing functions between emotionality and infantile stress were found as a function of changing the level of adult stress from a mild intensity (.3 ma.) to a strong intensity (.7 ma.), suggesting that the effects of infantile stress cannot be described in any simple fashion. A "stress inversion hypothesis" was advanced to account for the results. This hypothesis states that through the intermediate range of intensities of adult stress there is some sort of "threshold." Emotionality reactivity to a stress which is below this threshold bears a relationship to infantile stress which is opposite that found for emotional reactivity to a stress which is above this threshold. An erratic relationship exists between infantile stress and emotionality following the administration of an adult stress which centers directly around this threshold. Complex interactive relationships between learning and infantile stress interacting with critical periods and adult shock were obtained. Curvilinear relationships between learning and infantile stress, similar to those obtained by previous investigators, were obtained for some combinations of critical periods and intensities of unconditioned stimuli. However, other combinations produced linear functions between learning and infantile stress, suggesting that the generality of previous findings is limited to certain restricted conditions. Some indications that the effects of infantile stress upon learning may be obscured when learning is accomplished under conditions of a strong drive state were obtained.

The interactive nature of the critical periods, as opposed to being additive functions, suggested that qualitatively different mechanisms were operating during the various critical periods, and that stimulation during these periods may be effective for markedly different reasons.

Microfilm $2.50; Xerox $4.40. 81 pages.

AN EXPERIMENTAL EVALUATION OF CONTINUITY AND NON-CONTINUITY THEORIES OF DISCRIMINATION LEARNING

(L. C. Card No. Mic 59-4420)

Jack Irving Bradley, Ph.D.
The Claremont Graduate School, 1959

The purpose of this experimental investigation was to determine the manner in which a response to a stimulus cue is influenced by reinforcement and to determine which of the opposing theories of discrimination learning, continuity or non-continuity, can best explain the experimental results. In brief, the continuity theory holds that reinforcement should strengthen the S-R association of all stimulus cues striking S's sense receptors at the time of reinforcement; non-continuity theory holds that only those aspects of the total stimulus configuration that are specifically attended by the S are influenced by the reinforcement.

In two experiments, the S's were presented a discrimination task in which incidental stimulus cues were included at differing frequencies in the total stimulus complex. These individual stimulus cues may or may not have been used by the S's as a basis for making a reinforced response. In the second experimental task of experiment one and beginning with the eleventh trial of the experimental task in experiment two the incidental stimulus cues became critical cues in order to determine: (1) the associative response strength resulting from the inclusion of the stimulus cue in the discrimination trials of the first experimental task in experiment one and trials one through ten of the experimental task of experiment two respectively; and (2) the relative effect on associative response strength of having either tried or not tried the stimulus cue as a basis for a response during the trials when the cue was not critical. The associative response strength was measured by the savings method in terms of the required trials to learn to respond to the incidental cue when it became the critical cue as compared with the number of trials required to learn such a response when the critical cue was novel.

The results of the experiment yielded no significant difference between the groups who had had the incidental stimulus cue present at the time of reinforcement when compared to a control group performing a novel task. A comparison of the S's who had tried a response based on the incidental cue with the S's who had not showed the tried group learned the second task in significantly fewer trials. A subsequent analysis showed no facilitation in learning as a result of repeated trials based upon the incidental cue in the group of S's who had tried the cue.

The following conclusions were drawn from the results of the two experiments:

1. An increase in response tendency may be developed selectively only to those stimulus cues in a stimulus configuration which have determined the occurrence of the response.
2. Repetitive, reinforced responses to a particular stimulus cue have no cumulative effect on the associative response tendency.

These conclusions support the basic premises of the non-continuity theory of discrimination and are contrary to the premises of the continuity theory.

Microfilm $2.50; Xerox $5.20. 101 pages.

THE EFFECT OF LAG ON OPERATOR EFFICIENCY IN A TRACKING TASK

(L. C. Card No. Mic 59-6629)

Jack Ervin Conklin, Ph.D.
The Ohio State University, 1954

Skilled performance in a continuous tracking task requires anticipatory behavior on the part of the operator. Predictions about the future state of the system compensate for the basic intermittency of his own behavior. The operator can then simulate a response output which is a continuous function of the problem. Good prognostications, therefore, should increase tracking efficiency. Task variables that interfere with predictions should suscitate the intermittency of the operator and lower tracking performance.

Predictive behavior can be undermined, for example by the presence of lag between the control and display. Lag does not allow the operator to perceive his output instantaneously by visual feedback. Immediate verification of his predictions, therefore, is absent. Without this information, anticipatory responses become increasingly difficult.

Transmission lag can be contrasted with asymptotic or exponential lag. Following a control movement, a fixed time interval can expire before information relative to this movement is visually displayed. This is termed transmission lag. Asymptotic lag, however, produces an exponential output of control displacement. The consequence of a control movement is immediately perceived, in part, but attains completion as an exponential function of time. Conventionally, asymptotic lag is defined as the time interval between the control input and 63 per cent of the maximum output.

Transmission control lags up to 0.32 seconds were investigated by Warrick.[1] On a compensatory display, the target was set into motion by a mixture of two periodic components, 6 and 30 cycles per minute. Time-on-target scores were found to decrease progressively as the delay interval was increased. He noted that attenuation of tracking performance occurred with transmission lags as short as 0.06 second. Investigation disclosed that the threshold for the perception of control lag was also at this value.[2] Lag diminished tracking efficiency even when the operator was not aware of its presence.

In another experiment, Warrick[3] studied compensatory tracking with exponential lag. Three values of control sensitivity (15, 45, and 65 degrees of knob rotation), three target frequencies (1/3, 1/4, and 1/5 cycles per second), and three lag time constants (0.005, 0.105, and 0.255 seconds) were employed. Time-on-target scores declined with an increase in target frequency and asymptotic lag. A change in control sensitivity had little effect on tracking efficiency. A significant interaction between frequency and lag suggested that as target frequency increased, lag became increasingly detrimental.

In a recent study by Levine,[4] exponential lag was varied between 0.015 second and 2.70 seconds, with a compensatory display. Target motion was derived by a mixture of three frequencies with equal amplitudes, 3, 5, and 11 cycles per minute. Levine observed a linear relationship between tracking efficiency and asymptotic lag for values of from 0.15 second to 2.70 seconds. From 0.0 second to 0.15 second, however, the function assumed an exponential shape. He also found that tracking performance was successful with the longest lag, 2.70 seconds. The mean time-on-target measure for his subjects was 13.6 seconds. With the control maintained in a neutral position, the time-on-target value of the signal was only 4.2 seconds.

The present experiment was designed (a) to determine that value of lag at which skilled performance breaks down, and (b) to evaluate the linearity of the function for values of lag up to 1.0 second. Tracking performance was observed with the pursuit and compensatory display and five different target courses. An additional experimental variable was the nature of the control lag function. Lag was introduced by an electrical filter network. Keeping the time to reach 63 per cent of maximum output constant, the writer found that the function was exponential when one filter network (filter X) was employed, but had a different shape when two networks (filter Y) were cascaded. The function derived with a two-filter network was intermediate between asymptotic and transmission lags. In response to a step-function input there was an initial positive acceleration which changed to negative as maximum output was approached.

An earlier model of the Electronic Pursuit Apparatus employed in this experiment is described elsewhere.[5] The display was presented on a 5 inch cathode ray tube (CRT). The target was represented by a vertical line 1/16 inch wide and 5/8 inch long. Displayed beneath the target (and slightly overlapping) was a second line simulating the cursor. The operator was seated approximately 28 inches from the CRT. All motion was horizontal. Both target and cursor contrasted well to surrounding conditions.

The control was constituted of a horizontal lever with an elbow rest at one end and a knob to grasp at the other. Control movements, therefore, consisted of an angular rotation about the elbow. The knob position with respect to the elbow was adjusted to the arm length of each subject. Throughout the experiment the sensitivity of the arm control was held constant. An angular rotation of 5 degrees moved the cursor 2 inches on the display.

With the pursuit display, target and cursor movements were activated independently. Target motion was determined by the target course generator. The cursor was controlled by the subject. The compensatory display differed in that the target remained stationary in the center of the CRT. Movements of the cursor were the result of both target course input and the subject's control movements. With either display, the tracking task was to maintain a continuous alignment of target and cursor.

Inasmuch as the display scale factor was held constant at 2 inches, target course inputs were regulated so that the maximum amplitude for any particular signal did not exceed this value. This introduced a difference among the root mean squared (rms) error values among the different targets employed. In order to compare directly the tracking performance with different target conditions, therefore, a criterion independent of the signal rms error was prerequisite. One such criterion was the ratio of the signal rms error to that of the subject's rms tracking error. This transformation had the advantages of equating different target course inputs so that they could be directly compared, and of determining the level of performance at which the subject is tracking with respect to "chance", the score he would have obtained if he centered the control and held it stationary throughout the tracking period. Performance measures greater than 1.0

indicated the extent to which the tracking was better than "chance".

The mean tracking performance of three skilled subjects was measured for five values of lag, 0.0, 0.25, 1.0, 4.0, and 16.0 seconds. Three targets differing in intricacy (π, $\pi + 2/3\pi$, and $\pi + 2/3\pi + 1/6\pi$ radians per second) and one random signal were employed. Secondly, the differential effect of lag on target frequency (π and $1/6\pi$ radians per second) was studied with two skilled subjects. Finally, control lags between 0.0 second and 1.0 second at a 0.2 second interval was studied. One highly skilled subject tracked all the targets employed except the random signal. He tracked 10 trials under every experimental condition. Filters X and Y were studied separately for all the task conditions.

It was found that tracking efficiency significantly decreased as lag was increased from 0.0 second to 16.0 seconds. Performance decrement was also significantly greater for filter Y than X. Tracking performance with the random signal, however, dropped to a "chance" level when the shortest lag was inserted between the control and display. The sinusoidal target, $1/6\pi$ radians per second, allowed the best performance. At 16.0 seconds lag with filter X, tracking efficiency was relatively good, but with filter Y, tracking proficiency reduced to "chance" behavior. Results for the remaining three target courses were identical. With filter X, performance was better than "chance" up to 16.0 seconds lag. Tracking proficiency broke down with filter Y at 4.0 seconds lag.

Instability in subject performance was apparent with the long delays and filter Y. The effect was most striking with the random target course. In attempting to reduce perceived error, subjects achieved a performance score considerably below "chance." Had the subjects centered the control and held it stationary during the difficult tracking tasks, rms ration scores would have been at least 1.0. As it turned out, some of the rms ratio scores were below 0.60.

For the shorter time constants, tracking with the pursuit display was much superior to the compensatory display. In general, the change from pursuit to compensatory tracking led to at least a 50 per cent drop in ratio scores. These differences disappeared, however, as time constants were increased. Tracking performance deteriorated to "chance" behavior for example at precisely the same lag values with either display. Tracking with the pursuit display and 1.0 second lag, however, was superior to compensatory tracking with 0.0 second lag for every target course studied except the random signal.

For time constants between 0.0 second and 1.0 second, tracking performance was, in general, a linear function of control lag. Curve fitting by means of orthogonal polynomials showed that only three of the eight curves with the pursuit display were nonlinear. Only one of the eight curves with the compensatory display, however, deviated from linearity.

Significant differences in slope were found between the curves of filters X and Y up to 1.0 second lag. The single exception was with the compensatory display and target frequency of π radians per second. That introducing lag with filter Y reduced tracking efficiency at a faster rate than with filter X is clearly shown by these results.

The results of the study support the general hypothesis. Skilled behavior in a perceptual-motor task depends, to a large extent, upon the subject's ability to anticipate and predict the future course of events. By this means the subject compensates for his own "functional discontinuities." Alterations in the stimulus conditions which hinder good predictions, therefore, seriously impair tracking efficiency.

The basis for prediction in a continuous tracking task is based on two factors. (1) Long term predictions are developed by a learning process—the subject learns something about pattern of target motion. (2) Short term predictions are mediated by the perception of rates and direction of target motion. The manipulations of experimental variables primarily affect the short term predictions. This interpretation is supported by (a) the complete deterioration of tracking efficiency with the random signal when a short control lag is present, (b) extreme differences found in tracking through filters X and Y, and (c) the differential proficiency found in tracking with the pursuit and compensatory displays.

The random course generator has a peak power of π radians per second—introducing, therefore, periodicities of target movement at this frequency. This condition makes it possible for a skilled subject to achieve slightly better than "chance" performance when there is no lag in the control circuit. Since the subject cannot learn completely the complex pattern of the random signal, his tracking performance is primarily dependent upon short term predictions. When lag is inserted, predictions become impossible and the subject can no longer perform as a stable element in the system. Any effort to track on his part is likely to lead to an actual increase in error beyond the value it would reach if he did nothing.

A second example of the significance of predictive behavior in tracking is given by the results with filters X and Y. The primary difference between these filters is the shape of the control output function. The asymptotic output (filter X) permits, in part, immediate verification of a control movement, whereas the output for filter Y is initially zero. The results show that performance is considerably poorer when lag is introduced with filter Y. This is not owing to the subject's inability to learn the pattern of target movement, sine wave, but rather to the lack of immediate verification of short term predictions. With filter X, subjects receive some immediate information about their control movements. Lacking this initial information with filter Y, however, predictions become uncertain and tracking efficiency falls off at a rapid rate as lag is increased.

The assumption that anticipatory or predictive behavior is essential for adequate tracking performance is further supported by the consistent differences found between pursuit and compensatory tracking. Under comparable conditions of lag and target intricacy, performance with the compensatory display is always inferior. Difficulty arises in using the compensatory display as a basis for predictions, since the motion of the target is confounded with control movements. It is very difficult for the subject to differentiate these two effects. In addition, the subject receives no information about target rates or direction of motion when cursor and target are aligned. He must depend primarily upon displacement cues which give little predictive information. Perfect alignment of target and cursor with the pursuit display, however, does not impair predictions. Target rates and direction are clearly perceptible and they present informational cues essential for skilled performance. Microfilm $2.50; Xerox $5.20. 105 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

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5. Warren, C. E., Clark, J. R., and Fontaine, A. B. "A Two-dimensional Electronic Pursuit Apparatus," Human Resources Research Center, Lackland AFB, Research Bulletin 52-26, 1952.

Abstract published by special arrangement with The Ohio State University.

CONTINUITY AND NON-CONTINUITY IN HUMAN SERIAL LEARNING

(L. C. Card No. Mic 59-4421)

Arnold Melvin Cooper, Ph.D.
The Claremont Graduate School, 1959

Purpose. These experiments were designed to explore the effect of the organization of the stimulus complex and the differentiation of tasks on the process of serial reversal learning with human subjects. It was hoped that such experiments would indicate whether or not the contradictory evidence which has been offered by both sides in the continuity - non-continuity controversy might be partly attributable to uncontrolled variables.

A field theoretical analysis of the learning process was made, and hypotheses relating to the conditions under which operationally defined "continuity" or "non-continuity" should appear were stated.

Sample. The subjects were ninety naive freshman introductory psychology students from a California state college. Subjects were randomly assigned to one of the three experiments, and to experimental and control groups within the experiments.

Tasks. Subjects were required to learn a color series with each color presented singly, to a criterion of two perfect runs of the series. The colors were presented as cards, and two types of tasks were used, a heterogeneous task and a homogeneous task.

Experiment I. This experiment explored heterogeneous tasks whose pre-reversal and reversal phases were differentiated either by closure of the task by the subject or by the verbal instructions of the experimenter.

Experiment II. This experiment explored the effect of figure-ground relationships within a heterogeneous task. Experimental groups were tested under conditions of figure reversal and ground reversal while still in the pre-solution state relative to the total task complex.

Experiment III. This experiment involved pre-solution reversals of a homogeneous task. It was designed as a further check on the independent variables manipulated in Experiments I and II.

Results. The results indicate that the hypotheses derived from the stated theory was tenable. Within the limits of the experimental situation, continuity and non-continuity were manifested as a function of figure-ground relationships and the differentiation of pre- and post-reversal tasks. Positive transfer was found under certain conditions and was presumed to be attributable to transfer of pattern independent of the specific associative connections between the stimulus elements comprising the tasks.

Conclusions. While the conflicting evidence is not explained away by the results of these experiments, the results indicate that future attempts to explore the question of the continuity of the learning process should consider the possible effects of perceptual and organizational factors. The results obtained are orderable within a field-theoretical framework, but it is suggested that the positive transfer of pattern data poses serious difficulties for the S-R theorist. Microfilm $2.50; Xerox $6.20. 130 pages.

THE EFFECTS OF ELECTRICAL SHOCK ON THE ACQUISITION OF A VERBAL EXPECTANCY

(L. C. Card No. Mic 59-6096)

Edward E. Eddowes, Ph.D.
The University of Florida, 1959

The effects of electrical shock on the prediction of uncertain alternative events were studied in relation to the statistical association theory of learning and the law of effect. The total performance and the final level of responding were analyzed with respect to the number of predictions of the less frequently occurring event and the number of errors in terms of the predicted outcomes of the two theories.

Eighty college students were run individually in a standard experimental situation. Each trial consisted of a signal light which came on and stayed on until the subject predicted, by moving a switch to the right or left, which of two event lights would come on. On the first 120 trials the event lights came on randomly on either side and with the probabilities of .05, .15, and .40 for different groups. On a second series of 80 trials, the lights came on randomly and with the probability of .20 for all groups. Ten subjects in each probability category served as an experimental group and received a mild electrical shock after an incorrect prediction. In these groups, shock served to differentiate the consequences of a correct as compared with an incorrect prediction. Another 10 subjects in each probability category served as a control group and did not receive shock on an incorrect prediction. Two additional groups of 10 subjects each were run in the .05 and .15 probability categories and served as control groups to test the effects of the contingency of shock on an incorrect prediction. These subjects were shocked exactly as the subjects in the shock-wrong groups, but without regard to the correctness or incorrectness of their predictions.

Theoretical predictions as to the final number of predictions and errors were generated from the statistical association theory and were tested against the predictions based on the law of effect. The data in general supported the predictions of the statistical association theory with respect to the final number of predictions and errors. Only in the case of the .05 probability groups was the

difference between mean number of predictions of the less frequently occurring event and mean number of errors significant.

Tests of the over-all differences between the no-shock and shock-wrong groups showed that the .05 probability groups differed significantly, that the .15 probability groups differed slightly and consistently but not significantly, and that the .40 probability groups did not differ significantly. These findings led to the development of a hypothesis which suggested that the effects of shock increased as the probability of occurrence of the event predicted decreased from .50 to .00, and that the effects of shock were not sufficient to result in significant differences between final performance levels of the no-shock and shock-wrong groups.

Analysis of the differences between the performances of the shock-wrong and noncontingent-shock groups indicated that where the no-shock and shock-wrong groups differed, the difference was the result of the shock following an incorrect prediction and not the result of shock alone. Analysis of reaction latency data failed to reveal any differences between the various no-shock and shock-wrong and shock-wrong and noncontingent-shock groups.

On the basis of the results of this experiment it was concluded that the generality of the statistical association theory could not be extended without some modification to situations such as were used in this study.

Microfilm $2.50; Xerox $4.20. 79 pages.

THE TEMPORARY EFFECTS OF VARYING AMOUNTS OF ALCOHOL ON ABSTRACT THINKING EFFICIENCY

(L. C. Card No. Mic 59-6479)

Jeene Wilbur Gaines, Jr., Ph.D.
Purdue University, 1959

Major Professor: L. M. Baker

An experiment was conducted to test the hypotheses that (1) alcohol impairs abstract thinking, (2) that amount of impairment is related to amount of alcohol consumed, and (3) that some types of thinking tasks will show more impairment than others.

Sixty four white male subjects, 21 years of age and over, were randomly assigned to four groups. The groups represented two levels of alcohol intake (3 ounces and 6 ounces of 80 proof Vodka), a "placebo" group, and a "no drink" control group. All subjects were moderate drinkers. Intelligence level and education level of the subjects were both well above average.

Members of all four groups were tested together. Subjects were administered a battery of four tests of abstract thinking ability and then the members of the three drinking groups were served three drinks each, at specified time intervals. After the drinking, alternate forms of the four tests were administered. Tests were administered in counterbalanced order.

Statistical analysis of the data indicated that none of the hypotheses were supported. The 6 ounce group showed significant impairment of efficiency as compared to the Control group on the Addition Test, but not on the other tests. With one exception, all groups performed better on the second testing. However, inspection of the data indicates that some subjects in the two alcohol groups did show marked improvement on some tests after ingestion of alcohol.

The most significant finding was that both the Placebo and 3 ounce groups performed markedly better after drinking than either the Control or 6 ounce groups. This "facilitating" effect was discussed in terms of anxiety reduction. The overall results were interpreted as indicating a need to closely scrutinize and reformulate current theories regarding the temporary effects of alcohol on thinking processes.

Suggestions were made for further research in the area.

Microfilm $2.50; Xerox $3.00. 51 pages.

INVESTIGATION OF OPERANT AVOIDANCE BEHAVIOR IN CHILDREN

(L. C. Card No. Mic 59-5551)

John Thomas Hammack, Ph.D.
The University of North Carolina, 1959

Supervisor: Eugene R. Long, Jr.

The present study was designed to assess the feasibility of using operant conditioning techniques to study avoidance behavior in children. Specifically, an attempt was made to assess the reinforcing properties of various schedules and to control experimental avoidance behavior by using a time-out from positive reinforcement as the aversive event to be avoided. Forty-two children, ranging in age from four to six years, served as subjects. In accordance with the Ferster technique two behavioral repertoires were established and maintained simultaneously in each child. Two manipulanda were made available. Responses on one manipulandum during a given session were reinforced on one of several intermittent schedules of positive reinforcement (i.e., on VI 1, VI $\frac{1}{2}$, or FR 25). In order to maintain a given schedule of reinforcement on the first manipulandum, however, the child occasionally had to operate a second manipulandum, i.e., had to make at least one response on the second manipulandum within a specified constant interval of time (the response-time-out interval). If no response was made on the second manipulandum within this time interval, the schedule on the first manipulandum was disconnected (electrically) for a period of 30 seconds (length of time-out period), and responses on the first manipulandum were never reinforced. At the end of the 30-second time-out period, the positive schedule was reinstated (electrically), and reinforcement could be obtained on the same schedule as before.

Major findings of the experiment are listed below.

1. The time-out from positive reinforcement was found to constitute an aversive event which, for the most part, was avoided by the children.
2. Rates of responding on each manipulandum were negatively correlated with size of the variable interval schedule of reinforcement.
3. Rates of responding on each manipulandum were higher on an FR 25 than on a VI 1 schedule of reinforcement.
4. Shortening the length of the response-time-out interval produced an increase in rate of avoidance responding.

5. Rate of responding on the schedule-reinforced manipulandum was higher, for the same schedule of reinforcement, when the avoidance contingency was programmed concurrently.

6. "Superstitious" reinforcement tended to produce non-independent responding on both manipulanda.

7. Many children showed a general motivational decline in later sessions of the experiment.

Microfilm $2.50; Xerox $4.60. 87 pages.

THE EFFECT OF ELECTRO-CONVULSIVE SHOCK ON RETENTION AS A FUNCTION OF STIMULUS SIMILARITY IN TWO SUCCESSIVE HABITS

(L. C. Card No. Mic 59-5517)

Francois Haravey, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Irwin A. Berg

The purpose of this study was to determine whether the effect of electro-convulsive shock (ECS) on the retention of the more recent of two successive habits varies as a function of the stimulus similarity between them.

A series of four simultaneous brightness discrimination tasks was constructed by employing successive points along a basis of equal appearing intervals. The discrimination problems derived in this manner were found to be of equal difficulty when tested on rats.

Five groups of rats, with 16 Ss per group, were assigned randomly to five treatment conditions. The experimental variable was the degree of similarity between Task A and Task B, where Task B was the same for all groups. Group I received no training on Task A; in Group V, Task A was identical to Task B.

All Ss in Group II through V were given 20 massed trials on Task A with an inter-trial interval of 45 sec. Twenty-four hours later, all five groups received 20 massed trials on Task B. Thirty sec. after completing trial 20, each experimental S received one ECS. Twenty-four hours after training on Task B, all Ss were given an additional 30 trials on the problem. The number of errors made during the post-shock training constituted the index of retention.

The results of the experiment indicated that a moderate but consistent tendency exists to the effect that retention of Task B is decreasingly affected by ECS with increasing similarity to Task A. In other words, the decrement in retention of Task B following ECS tends to be an inverse function of its similarity to Task A. However, the F test for interaction (ECS x similarity) did not attain the .05 level of significance.

Microfilm $2.50; Xerox $4.60. 88 pages.

THE EFFECTS OF DRIVE STRENGTH AND QUANTITY OF INCENTIVE UPON DISCRIMINATION LEARNING AND RUNNING TIMES IN THE WHITE RAT

(L. C. Card No. Mic 59-5387)

Walter Isaac, Ph.D.
The Ohio State University, 1953

The relevent literature is reviewed and discussed. It is noted that there is a lack of research in which both drive strength and quantity of incentive are investigated and compared in comparable situations. The dissertation is designed to partially fill this gap in our knowledge.

Ninety-nine white rats selected at random from the colony at the Ohio State University were used as subjects. All animals were given pretraining in a short runway under water deprivation with a water incentive.

The animals were divided into nine groups of 11 animals each. The nine groups were arranged in a factorial design utilizing three levels of drive strength and three quantities of incentive. The drive levels used were 5, 10, and 20 hours food deprivation. The three incentive levels used were 2, 4, and 8 pellets of food, each pellet weighing .2 gram.

All animals were tested for 30 days in a modified Grice box, where a black versus white discrimination was the required task. One reinforced trial per day was given. The animals were allowed to consume the total incentive. Following this test the animals were given 25 trials, one per day, in an 18 foot straight alley runway.

The performance measures taken in the discrimination box were error scores, latencies in the starting box, and length of time required to make a choice between the stimuli. In the straight runway the running times in each third of the runway were obtained along with the time required to traverse the entire runway. Latencies in the starting box were also obtained. In all cases time scores were converted to logarithms. Analysis of variance was used in the statistical analysis of the results. If warranted by the results of the analysis of variance, t-ratios between groups were calculated.

In the discrimination apparatus, differences between both starting box latencies and error scores were obtained as a function of drive strength. A positive correlation between choice times and error scores was obtained.

Significant differences were found between the running times of the subjects as a function of both drive strength and quantity of incentive. It was found, however, that when the running times were analyzed further, only the mean running times in the first sector of the runway differed significantly.

The similarity in function of varying drive strengths and quantities of incentives was noted. This is discussed as substantiating evidence for the equivalent role given these variables in the composition of reaction potential in the behavior system proposed by Hull.

Microfilm $2.50; Xerox $4.00. 75 pages.

Abstract published by special arrangement with The Ohio State University.

AN EXPERIMENTAL INVESTIGATION OF TWO THEORIES OF RETROACTIVE INTERFERENCE AS THEY APPLY TO THE RETENTION OF PAIRED-ASSOCIATES NONSENSE MATERIAL

(L. C. Card No. Mic 59-4425)

Luther Brown Jennings, Ph.D.
The Claremont Graduate School, 1959

It was the purpose of this investigation to determine the relative adequacy of the explanations offered by certain Gestalt theorists and by those who have developed the response-interference theory of retroactive interference among paired-associates nonsense materials.

Those espousing the response-interference theory contend that retroactive interference in paired-associates nonsense material arises from the mutual interference of the response members of the unidirectionally associated pairs. The Gestalt group contends that retroactive interference arising out of the learning of paired-associates nonsense material results primarily from the fact that homogeneous materials aggregate, thus losing their individual integrity. This group also contends that the relationship between the members of pairs is bidirectional, either member being able to arouse the other. Thus, this group contends that the interference which the response-interference theorists have found among response members of pairs can be shown to exist among stimulus members of pairs as well.

Two experiments were designed to critically evaluate these different views of retroactive interference and of the role that the relationship between members of paired-associates plays in determining it.

In the first experiment the difference in retention of isolated and aggregated pairs was compared with the difference in retention among arrangements designed to cause different amounts of retroactive interference learned under the same conditions of aggregation.

The second experiment was designed to discover whether the different types of retroaction resulting from the different arrangements of pairs customarily employed by the response-interference theorists can be demonstrated to exist among stimulus members of pairs as well as the response members of pairs.

The findings of the first experiment revealed that: (1) loss of retention due to aggregation was significantly greater than the difference in retention caused by different arrangements of pairs designed to cause different types of retroaction, and (2) the difference in the retention of the different arrangements was insignificant when they were learned under conditions of isolation or among eight or less aggregated elements.

The findings of the second experiment revealed that: (1) the differential and absolute retention of stimulus members subjected to the different types of retroaction resulting from the arrangements used by the response-interference theorists was as great as among response members subject to these same conditions, and (2) this similarity in the pattern and degree of retention of the stimulus and response members appeared whether or not learning occurred under conditions designed to maximize the development of unidirectional stimulus-response bonds between the members of a pair.

In general, the findings of both experiments supported the Gestalt theory and failed to substantiate the response-interference theory.

Microfilm $3.80; Xerox $12.80. 295 pages.

LEARNING IN THE ALBINO RAT AS A FUNCTION OF PRE-WEANING HANDLING AND DIFFERENT ADULT MOTIVATIONAL LEVELS

(L. C. Card No. Mic 59-6484)

George Gurnea Karas, Ph.D.
Purdue University, 1959

Major Professor: Victor H. Denenberg

The effects of infantile handling upon later learning in an underwater swimming maze which employed four different motivational levels were investigated. Rats handled from ages 1-10 days and 1-20 days as well as non-handled controls were used. In addition the infantile handled groups were split into spaced handled and massed handled groups. Testing extended from ages 51 days to 60 days.

Two acquisition measures, latency and number of errorless trials, were obtained. Analyses of variance were computed for the two measures, but the errorless trials measure was not as sensitive as the latency measure; therefore, only the latency measure was used. Comparisons were made between the control condition and the 1-10 massed and 1-20 massed treatments and between the controls and the 1-10 spaced and 1-20 spaced conditions. In addition the massed and spaced treatments were compared with one another. Results showed that at the lower motivational levels the controls generally performed the best, but at the highest motivational level the handled groups usually were most efficient. In the spaced vs. massed comparison the spaced treatment performed better during the first half of the trials generally while the reverse was true during the second half.

The results were interpreted in terms of the hypothesis that infantile handling should reduce emotionality and that spaced handling should have more of an effect upon emotional reduction than massed handling.

Microfilm $2.50; Xerox $3.00. 53 pages.

AN INVESTIGATION OF THE VALIDITY OF THE RORSCHACH TECHNIQUE IN PREDICTING SOCIABILITY

(L. C. Card No. Mic 59-6489)

Herbert Lange, Ph.D.
Purdue University, 1959

Major Professor: Lawrence M. Baker

In the Rorschach literature appear many assumptions about the human content responses (H, Hd). These assumptions indicate, in various ways, that human responses suggest an interest in other people. It was hypothesized that an interest in other people would manifest itself behaviorally through sociability. The operational definition

of sociability was limited but objective; it referred to the location or position and activity of a given individual in respect to his social group.

Efforts to evaluate single Rorschach factors are controversial. The controversy is related to the argument that various Rorschach factors are dynamically interrelated. Such a viewpoint insists that systematic Rorschach research must confine itself to a holistic or global appraisal of the Rorschach. In line with this, the present study also attempted to assess the efficacy with which global Rorschach appraisals could predict sociability.

Two experimentally testable hypotheses were advanced.

1. The number of human content responses to the Rorschach, by itself or in combination with other Rorschach factors, is related to sociability and able to predict it. The direction of this relationship is not specified.
2. Global Rorschach evaluation by expert judges should predict sociability as well as the human content responses or better.

Two groups were used as subjects in this investigation. One group consisted of 25 psychiatric patients living together on a psychiatric ward. The other group consisted of 17 undergraduate college students living together in a men's dormitory.

The criterion for the hospital patients was composed of three sources, direct ward observations by trained observers, nurses' ratings, and sociometric ratings, i.e., each patient rating every other patient. The criterion for the college students consisted of dormitory counselor's and sociometric ratings. Each criterion source represented a pooled score from a location and an activity factor for each subject. These two factors, in each instant but one, were rated on four-point scales developed for the study. The scores for each subject were combined by changing them into standard scores. The final criterion score was obtained by transforming each subject group's standard scores into rank-order arrays. Interrater reliabilities for the various criteria sources ranged from a Spearman's rho of .240 for the sociometric ratings to a Spearman's rho of .880 for direct observations. All were significant at the .01 level or better. The intercorrelations between the various criteria sources ranged upward from a Spearman's rho of .523, and were all significant at the .01 level or better.

The predictors for sociability, i.e., the human content responses and global Rorschach appraisals, were obtained by administering individual Rorschachs to all subjects. To correct for differences in the total number of responses, (H+Hd) :R ratios were then computed and transformed to rank-order arrays. The global Rorschach appraisals were obtained by having three Rorschach experts rate every protocol on a five-point scale of sociability. Criteria and predictors were then submitted to statistical analyses by using Spearman's rank-order correlations.

The results were inconclusive. A small but significant negative relationship (-.397) was established between (H+Hd) :R and the criterion for the hospital patients. However, this finding was not corroborated by the results obtained for the college students. It was concluded that human content responses cannot consistently predict sociability.

The global Rorschach approach showed that only one judge out of three was able to establish some small relationships between his ratings and the criteria of the two groups. It was concluded that 1) global Rorschach appraisals of sociability could not be systematically effected, and 2) the global Rorschach approach was in no way superior in predicting sociability than the human content responses. Microfilm $2.50; Xerox $5.40. 106 pages.

AN EXPERIMENTAL STUDY OF THE ROLE OF SENSORIMOTOR ACTIVITY IN THE MAINTENANCE OF VERBAL MEANING OF ACTION-WORDS

(L. C. Card No. Mic 59-6192)

Arnold Miller, Ph.D.
Clark University, 1959

Supervisor: Bernard Kaplan

This investigation deals with the effect of different kinds and degrees of action on the lapse of verbal meaning. By lapse of verbal meaning is meant the fact that people, rapidly repeating a word, soon experience it as meaningless. It was expected that such meaning loss entails a regressive process directed toward the utilization of experimentally introduced primitive modes of attaining meaning. These primitive modes of attaining meaning, e.g., overt sensorimotor activity, were considered to be required by the organism to maintain word signification.

Two hypotheses were advanced: One, that words repeated in the context of overt action would retain their meanings longer than such words without overt action accompaniment. Two, that the introduction of different kinds of overt action accompaniment would induce differentially facilitating effects. Taking words without action as a baseline, it was anticipated that Concordant Action (viz., pushing while repeating the word 'push') would have a maximally facilitating effect on word-meaning retention; Discordant Action (viz., pulling while repeating the word 'push') would have a lesser facilitating effect; and Tangential Action (viz., lowering while repeating the word 'push') the least facilitating effect.

To establish an experimental situation capable of testing these hypotheses, subjects were required to repeat the words 'push' and 'lift' under the different action conditions. Two experiments were performed with 16 subjects in each experiment. The first experiment was concerned with the effect on retention of word-meaning of two different kinds of action under systematically varied stimulus conditions. The two actions were respectively Concordant and Discordant. The varied stimulus conditions included Concordant and Discordant Action performed in the context of Eyes Open vs. Eyes Closed (looking at the action being performed or not looking) and Object vs. No Object involved in the two kinds of actions.

The second experiment was concerned with the effect of three different kinds of action, under constant stimulus conditions (eyes always open, object always involved in the action). In all there were four conditions used in this experiment. The first two were Concordant and Discordant Action, the third dealt with Tangential Action, and the fourth consisted of repeating the words 'push' and 'lift'

without any overt action (but with assumed implicit action) accompaniment.

The results of both experiments confirmed the two hypothesis, viz., that action-words accompanied by overt action would retain their meaning longer than words unaccompanied by overt action was confirmed. With regard to the second hypothesis, viz., concerning the differential effects of Concordant, Discordant, and Tangential Action, it was found, consonant with expectations, that Concordant Action had most effect on retention, Discordant next, and Tangential Action, least.

One may note an additional finding, viz., that increased object and visual involvement in the context of Concordant Action led to maximum retention of word-meaning; such object and visual involvement in the context of Discordant Action did not lead to any significant increase in retention above that provided by Discordant Action per se.

These results, as well as clinical material, suggest that impairment of the meaning of a verbal vehicle establishes a deficit state in the organism. This deficit state is considered to induce a regression directed towards the utilization of lower levels of functioning (overt action accompaniment) in order to retain meaning. The extent to which a particular sensorimotor act may be facilitative of a particular word meaning is considered to depend on the extent to which the overt action context either shares or may potentially share a similar vector with the impaired word-meaning.

Microfilm $2.50; Xerox $4.00. 71 pages.

METHOD OF PLACEMENT AND DIFFERENTIAL TRAINING IN A DIRECT-PLACEMENT FEEDING SITUATION AS FACTORS IN INSTRUMENTAL PERFORMANCE

(L. C. Card No. Mic 59-5452)

William Walter Nish, Ph.D.
State College of Washington, 1959

Supervisor: Dr. H. A. Shoemaker

This study was concerned with an evaluation of Kenneth W. Spence's suggested method testing his incentive motivation theory as presented in his 1956 book, Behavior Theory and Conditioning. Spence has suggested an experimental model involving training animals on an instrumental response, exposing them repeatedly to goal box cues in the presence of reward in order to increase incentive motivation, and measuring the effect of these direct feedings on the instrumental response. The results of two published experiments using this procedure have failed to support Spence's predictions as to how the direct-feeding training should affect the instrumental response. It is suggested that this may be due to the following deficiencies in the experimental procedure.

1. The animals may have learned competitional instrumental responses during the direct feedings.
2. The animals did not have interfering responses extinguished to the same degree in the instrumental response situation.
3. The time measures of performance used might have reflected the interference of competitional responses learned in the direct-placement training.
4. The cues of the direct-placement goal box may not have been distinctive enough to result in association of the cues with the consummatory response.

This study also used Spence's direct-placement technique, but an attempt was made to correct the factors involved in the above criticisms. In order to test the importance of competitional responses learned in the direct-placement procedure, two methods of placing the animals in the direct-placement goal box were used. One method involved instrumental responses assumed to facilitate the original instrumental response, and the other method involved instrumental responses assumed to compete with the original instrumental response.

Interfering responses were extinguished to the same degree for all groups in the instrumental response situation by giving all groups exactly the same training up to the first day of direct-placement trials. A probability of response measure of performance was used as well as time measures. There was an attempt to make the cues of the direct-placement goal box more distinctive by giving differential training with one of the main cues of the goal box to some of the groups. Four experimental and three control groups were used in the study with ten rats in each group.

Spence's predictions concerning the effect of changes in incentive motivation as the result of the direct-placement training were not supported. The only variable in the study which proved to be significant was the manner of placement in the direct-feeding goal box. Groups which, while in the goal box, made instrumental responses which were assumed to compete with the original instrumental response did perform the instrumental response at a lower level following the direct placements.

It is concluded that the instrumental responses which the animals learn in the direct-placement training are an important factor which Spence has neglected in his suggested experimental outline. The effects of these interfering responses could be such that changes in incentive motivation do not show up in performance. It is also concluded that time measures of performance may be inappropriate measures of changes in incentive motivation as a result of direct placements. In this study, time measures reflected the effects of competitional instrumental responses learned in the direct-placement goal box.

Microfilm $2.50; Xerox $3.00. 42 pages.

AN INVESTIGATION OF FIGURAL ADAPTATION WITHIN THE FRAMEWORK OF SENSORY-TONIC FIELD THEORY

(L. C. Card No. Mic 59-6193)

Sonoko Ohwaki, Ph.D.
Clark University, 1959

Supervisor: Seymour Wapner

Figural adaptation is defined as systematic changes in perception that occur when the normal conditions of

stimulation are disturbed by distorting media such as prisms. Systematic changes of this sort are in effect directed toward establishing an orderly world. Assuming that a proximal stimulation coming from a certain physical stimulus is in stable relationship to a particular aspect of the organismic state, figural adaptation means that a relevant aspect of the organismic state changes in time so that a new and stable relation is established between the changed proximal stimulation and the changed organismic state.

Figural adaptation was tested with respect to three perceptual properties: orientation, form, and size. In Experiment I, Ss were exposed to a field rotated 20 degrees clockwise and the effect was measured with respect to perception of verticality. In Experiment II, Ss were exposed to a field in which all vertical lines were physically convexed to the right and the effect was measured with respect to change in perception of straightness of a line. In Experiment III, Ss were exposed to a physically magnified field and apparent size of head width and pencil length was measured. In each of the experiments the measurements were taken during four tests separated over time: (1) Pretest, taken before introduction of distorting media, (2) Posttest I, taken immediately after the removal of the distorting media, following 10 or 15 minutes of adaptation (wearing distorting prisms), (3) Posttest II, taken three minutes after Posttest I, and (4) Posttest III, taken five or seven minutes after Posttest II, or, following a total of eight or 10 minutes of readaptation.

The findings were as follows: With respect to perception of verticality and straightness, significant changes in perception were found for the right eye (exposed to the deflected field) and for the left eye (unexposed); moreover, significant adaptation was obtained for perception of verticality in kinesthetic modality, and a trend in this direction for straightness. These interocular and crossmodality effects of figural adaptation provide evidence that figural adaptation cannot be interpreted in terms of changes within a sensory surface or any restricted area in the nervous system, but rather in terms of changes in the total organism.

The process of readaptation occurs following adaptation and refers to changes in the perception pertaining to the physical field, toward a perception which obtains under normal conditions. It was found that Ss exposed to an undeflected (normal) field during the readaptation period, showed faster readaptation than those who were exposed to reduced visual stimuli (dark room) during the same period. This result is interpreted as follows: exposure of the S to the undeflected field provided a greater amount of stimuli incongruent with the existing organismic state; this greater degree of congruity facilitated the change in organismic state.

No systematic change was found with respect to figural adaptation to a magnified field. Possible factors which may account for this were discussed.

It was concluded that this investigation provides evidence that the process of figural adaptation through which an orderly perceptual world is established, is a process which involves the total organism.

Microfilm $2.50; Xerox $7.80. 167 pages.

THE EFFECTS OF CHRONIC ALCOHOL CONSUMPTION ON THE LEARNING AND MOTIVATION IN THE RAT

(L. C. Card No. Mic 59-6505)

Albert Andrew Pawlowski, Ph.D.
Purdue University, 1959

Major Professor: Victor H. Denenberg

This investigation consists of seven independent but related experiments on the effects of chronic alcohol consumption on the behavior of the white rat. Chronic drinking of ethyl alcohol was induced by restricting fluid intake to the alcohol solution. Pre-treatment and post-treatment behavioral studies were made and physiological measures were obtained at post-mortem.

The first series of three experiments was based on food reward. It was demonstrated that alcohol consumption slowed the rate of acquisition of the bar pressing response. No decline in the asymptotic rates of response was observed under alcohol treatment.

The second series of two experiments used shock-reduction as the drive. Differences in the asymptote of performance were shown to be the result of slower escape responses in the alcohol-treated animals. Retention was shown to have been impaired in the alcohol group when treatment intervened between acquisition and extinction. This difference was shown in the performance of rats pre-treated with alcohol and in the performance of rats re-acquiring the escape response after alcohol had been given subsequent to the original learning. All treatment groups were equated for escape-time on the original learning before treatment was begun.

Another experiment demonstrated that alcohol depressed spontaneous running activity in the female rat. Other data indicated that rats drinking alcohol, but subsisting on a limited ration of food, also had depressed activity rates. These data indicated that alcohol per se depressed activity and that the calories of alcohol may have altered the hunger drive.

Another experiment indicated that the threshold for electroshock seizure in rats was raised by the chronic drinking of alcohol. Thresholds were determined for all rats undergoing behavioral experiments and these data indicate that thresholds were raised by chronic drinking.

Assessment of the endocrine system indicates that no impairment resulted from the chronic consumption of alcohol under the conditions of this investigation. Histological examination revealed no hepatic pathology.

The conclusions were made that differential behavioral effects were obtained under alcohol treatment by the use of different drives. Alcohol was shown to affect performance, retention and extinction when shock-reduction was used; only acquisition was shown to be affected in the food reward experiments. These differences indicate that alcohol had selective effects on different drives; consequently, differing behavioral effects were observed in alcohol-drinking rats when different rewards were used.

Microfilm $2.50; Xerox $7.60. 162 pages.

EFFECTS OF THREE ATTITUDINAL FACTORS ON INITIAL IMPRESSIONS OF INDIVIDUALS

(L. C. Card No. Mic 59-6108)

Calvin M. Pinkard, Jr., Ph.D.
The University of Florida, 1959

This study was undertaken to determine whether anticipations about a stimulus person would influence initial impressions of him, and whether these impressions could be related to observer differences in psychological security and authoritarianism. Since the stimulus person was a therapist, assumed to exemplify warmth and permissiveness, impressions could be interpreted as relating to the influence of these therapist characteristics on initial impressions.

It was hypothesized that expectations of warmth and permissiveness, as opposed to expectations of coldness and an autocratic attitude, would be associated with different initial impressions of a warm, permissive stimulus person (Hypothesis I), but that warmth and permissiveness would have an influence on these impressions even in subjects anticipating a cold, autocratic person (Hypothesis II). It was further hypothesized that differences in initial impressions of the stimulus person would be associated with the degree of psychological security and authoritarianism of the observers (Hypotheses III and IV).

In order to test these propositons 235 high school seniors were shown a film depicting a genuine counseling interview and asked to respond to a multiple choice questionnaire measuring impressions of the film characters. Preceding the film showing, approximately 30 per cent of the subjects read statements characterizing the counselor of the film as a warm, permissive person; 30 per cent read statements characterizing him as a cold, autocratic person; and 40 per cent read statements describing the physical characteristics of the room in which the counseling session took place. For convenience these groups of subjects were designated respectively the Warm, Cold, and Neutral Set Groups.

During a second experimental session the California F Scale and the Maslow Security-Insecurity Test were administered to all subjects. Four groups were selected from the total population to form a group earning high scores on the F Scale (authoritarian group), a group earning low scores on the F Scale (non-authoritarian group); and, a group earning high scores on the Security-Insecurity Test (insecure group), a group earning low scores on the Security-Insecurity Test (secure group). Each of these groups included subgroups of approximately equal representation from the Set Groups.

Values were assigned responses to questionnaire items and mean ratings and sigmas found for each group and subgroup on questionnaire items. Differences between groups and subgroups were evaluated by means of critical ratios, biserial r's, and Mann-Whitney U Scores.

Hypothesis I was supported since different anticipations about the stimulus person were associated with significant differences in impressions of him. The direction of the difference was for the Warm Set Group to find the counselor warmer and more permissive and possessing favorable traits to a greater degree than the Cold Set Group. The absolute character of impressions of the Cold Set Group lent support to the second hypothesis since many impressions of the counselor by this group indicated a warm, permissive or favorable impression.

Hypothesis III was unsupported by the experimental results. The secure group did not differ significantly from the insecure group in initial impressions. The data indicated some support for Hypothesis IV with the observed difference between the authoritarian and non-authoritarian groups being greater variability of impressions in the authoritarian group.

It is consistent with results of the study to suggest that an observer will react not only to the real characteristics of a counselor but to what he anticipates his characteristics will be. It is also consistent to suggest that warmth and permissiveness in a counselor will be detected by observers and associated with some benign impressions of a counselor regardless of negative anticipations about him.

Microfilm $2.50; Xerox $5.00. 96 pages.

FORM DISCRIMINATION AND LEARNING SET FORMATION BY TWO SPECIES OF SCIURUS AS A FUNCTION OF QUANTITATIVELY CONTROLLED STIMULUS PARAMETERS

(L. C. Card No. Mic 59-6506)

Gene Glover Pittman, Ph.D.
Purdue University, 1959

Major Professor: Kenneth M. Michels

This study represents an attempt to (1) investigate the perceptual learning ability of an arboreal, diurnal rodent, the squirrel, and (2) establish a methodology that will permit more valid comparison of animal subjects of various phyletic positions. The variable chosen was the number of sides in stimulus patterns, as it is related to difficulty of discrimination, measured by trials to a learning criterion.

Using a modification of the Wisconsin General Test Apparatus, a total of twelve animals representing two species of tree squirrels (Sciurus carolinensis and Sciurus niger) were tested on a series of three choice, oddity type problems to a learning criterion. Four classes of problems were established and samples were constructed for each class following procedures outlined by Attneave and Arnoult (1956). Primarily, the classes were defined in terms of the number of randomly chosen points (4, 5, 6, and 7) that were plotted and connected with such added restrictions as size, convex angles, points initially enclosed, etc. The resulting patterns were cut from black construction paper and mounted with white backgrounds on 2 x 2 inch wooden bases.

A systematic relationship between the difficulty of discrimination, measured by trials to a learning criterion, and the number of sides in the stimulus patterns used was demonstrated. Patterns with four sides proved most difficult, those with five sides were of medium difficulty, and the six and seven sided figures were easiest. There was some evidence that the animals improved in their ability to solve these discrimination problems as a function of the number of problems learned.

Microfilm $2.50; Xerox $3.60. 65 pages.

AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIPS BETWEEN GROUP SIZE, PRIOR-EXPERIENCE, RESPONSE-CERTAINTY, AND CONFORMITY.

(L. C. Card No. Mic 59-6511)

Leon Aaron Rosenberg, Ph.D.
Purdue University, 1959

Major Professor: Lawrence M. Baker

The present study was an empirical investigation in the area of conformity. This research dealt with (I) the effect of increasing the size of the group; (II) the relationship between group size and prior-experience variables (high partner prestige and failure experience); and (III) measures of response-certainty.

For this purpose, 200 male undergraduates were used as subjects. The procedure for producing conformity involved the estimation of the lengths of a series of lines (A_1) followed by a re-estimation (A_2) after the subjects had received length estimates from an influence source. A conformity score was computed for each subject using the formula: $C = A_2 - A_1$.

The group sizes used were 2, 3, 4, and 5. One-half of the subjects in each group underwent the prior-experience treatments before entering the group situation. The measures of response-certainty (the degree of inaccuracy that a subject expected for himself and for his partner) were obtained after the experiment was completed.

The results of the experiment clearly indicated that the relationship between group size and conformity was a curvilinear one. The four-member group produced the greatest amount of conformity with the five-member group showing a significant decrease.

The data also indicated that the variables of group size and prior-experience were additive in their effects at all levels of group sizes used and to approximately the same degree.

The measures of response-certainty were also found to be significantly related to conformity. The data supported an interpretation that conformity was related to a more positive evaluation of the influence source than of oneself.

Microfilm $2.50; Xerox $4.60. 89 pages.

SPECIFICITY AND GENERALITY OF AUTONOMIC FUNCTIONING: A DEVELOPMENTAL STUDY.

(L. C. Card No. Mic 59-6196)

William Vogel, Ph.D.
Clark University, 1959

Supervisor: Morton Wiener

An attempt was made to relate autonomic functioning to differences in developmental level of Ss, as measured by age and intelligence. Hypotheses were formulated in terms of Werner's theory of developmental level.

Thirty-six male Ss were selected, eighteen in each of two age groups. The young group averaged six years of age; the older group averaged sixteen years of age. Both age groups, old and young, consisted of three subgroups of six Ss each: feebleminded Ss, average intelligence Ss, and gifted intelligence Ss. Each S was twice exposed to a sound stressor condition and twice exposed to a cold pressor test condition. GSR, breathing rate, pulse rate, and finger volume were continuously recorded by means of a Grass polygraph; diastolic and systolic blood pressure and pressure pulse were recorded by the usual discontinuous method.

Hypotheses and results were as follows.

1. Autonomic specificity, a measure of autonomic response stereotypy first used by Lacey (1950) was found to decrease as an inverse function of age. No relationship was found between autonomic specificity and intelligence. These findings partially confirmed the hypothesis derived from Werner's theory of developmental level that stereotyped responses decrease as an inverse function of developmental level. However, this finding could also be handled from a maturational point of view.
2. More typical sympathetic responses to the stressors were evoked from older than from younger Ss. The most poorly integrated sympathetic responses were evoked from the younger, less intelligent Ss. This finding partially confirmed the hypothesis derived from Werner's theory of developmental level that there is an increase in evocation of integrated responses with increasing development.
3. Davis' and Buchwald's (1955) demonstrations of stimulus specificity were repeated; i.e., the cold pressor tests and sound stressors evoke singular patterns of autonomic response.
4. Feebleminded Ss display better discrimination of stimuli at the autonomic level than do either Ss of average intelligence or Ss of gifted intelligence. These findings support Werner's theory of developmental level which states that when the cortex is weakened, damaged, or underdeveloped functions (i.e., discrimination of stimuli) normally carried out at higher neural levels are performed at lower neural levels.
5. Feebleminded Ss and Ss of average and gifted intelligence display reliable differences in their autonomic responses. Feebleminded, gifted and average intelligence groups each have characteristic individual specificity; i.e., each group displays an idiosyncratic autonomic pattern of response, regardless of the nature of the stimulus situation. This finding supported the hypothesis derived from Werner's theory of developmental level which stated that reliable differences between the groups should appear.
6. Differences in stimulus specificity were found to be a function of differences in age of the Ss. This finding can be explained in terms of developmental level, learning theory, or maturation.
7. Younger Ss and feebleminded Ss were found to recover more quickly (i.e., return more quickly to base level) from stressors than older Ss or Ss of average or gifted intelligence. This finding was related to Werner's theory of developmental level. The quicker recovery of the developmentally lower groups was assumed to be a function of less preseveration of the stress at higher neural levels.

It was concluded that theories of developmental level have much to offer research in the area of autonomic functioning. Several lines of research were suggested by the results as interpreted in terms of developmental theory. Microfilm $2.50; Xerox $5.00. 96 pages.

STIMULUS VARIABLES AS RELATED TO DEPRIVATION GENERATED DIFFERENTIAL RATES OF RESPONSE

(L. C. Card No. Mic 59-5590)

Marcus Bishop Waller, Ph.D.
The University of North Carolina, 1959

Supervisor: Dr. Eugene R. Long

The present research explored the possibility that different rates of response generated by varying level of food deprivation could be brought under the control of correlated discriminative stimulus conditions. Four groups of white rats were run in the free operant situation on a two minute variable interval schedule of reinforcement. Deprivation level and stimulus conditions were varied for each group over twelve experimental sessions.

Two groups were run alternately at high and low deprivation levels for the twelve sessions. The remaining two groups were run consistently at either the high deprivation level or at the low deprivation level. Of the two groups run alternately at high and low deprivation levels one group had "like" stimulus conditions correlated with each deprivation level during sessions one to six. The other had "different" stimulus conditions so correlated for that period. Stimulus conditions were "reversed" for both groups during sessions seven to twelve - the previously "like" group changing to "different" and the previously "different" group changing to "like". The two groups run at a consistent deprivation level had "different" stimulus conditions correlated throughout. The stimulus conditions manipulated consisted of two lights varying in intensity and hue.

The dependent variables used in the analysis were derived from the maintained rate of response. Two measures were employed: the mean number of responses per minute, and the difference in mean number of responses per minute for each deprivation level.

An analysis of the data indicated that under the conditions of the present experiment no evidence was obtained for external control of deprivation generated differential rates. This was the case when the data were analyzed across groups where each group was run under different conditions, as well as within a single group when stimulus conditions were changed after a number of pairings of particular deprivation conditions and specific stimuli. A significant effect was found, however, which was due to the manipulation of the deprivation conditions at the time of running. Animals run successively at different deprivation levels had more similar rates for each deprivation condition than other animals run at either the high or the low deprivation level consistently.

The results were discussed with reference to future research in this area.

Microfilm $2.50; Xerox $4.40. 84 pages.

THE EFFECTS OF INSTRUCTIONS AND EXPECTED NUMBER OF TRIALS ON CHILDREN'S PROBABILITY LEARNING

(L. C. Card No. Mic 59-6730)

Morton Webster Weir, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Harold W. Stevenson

Two experiments were performed investigating the effects of instructions, expected task length, and age on children's performance in a probability learning task.

In Experiment I, Ss were tested in a three-stimulus situation with 50% random reinforcement of only one of the three possible responses. The Ss ranged in CA from 10.0 yr. to 13.0 yr. One-third of the Ss were told that it was possible to receive 100% reinforcement (perfect solution group), one-third were told that it was impossible to be right every time, but that there was a way they could be correct about one out of every two times (part solution group), and one-third were told nothing about the frequency of reinforcement they could expect (neutral group). Each of these groups was further divided into three subgroups on the basis of the number of trials they were told they would receive. One subgroup was told they would have 20 trials, another, 40 trials, and instructions for a third subgroup were indefinite concerning the number of trials. Actually, all Ss received 80 trials.

There were no significant differences resulting from the major experimental variables. This lack of results was interpreted as indicating that Ss in the part-solution group actively searched for a solution which would yield perfect prediction of occurrence of reinforcement, and consequently did not perform differently than Ss who were searching for 100% reinforcement (neutral and perfect solution groups.) It was also possible that motivation was so high among all Ss that it masked any effects of the experimental variables.

In Experiment II, Ss were selected at two age levels, 5.0-7.3 yr. and 9.2-13.0 yr. The younger group was included on the assumption that they would have less tendency to search for perfect predictability, and would be less highly motivated to succeed in adult-controlled tasks than would older Ss. The experimental procedure and task were the same as in Experiment I, except that the instructions were changed slightly. One-third of the Ss at each age level were told there was a way they could be rewarded on every trial; one-third were told they could only be correct part of the time, but were not, as in Experiment I, told how frequently they could be rewarded; and one-third were given neutral instructions.

Results indicated the younger Ss chose the reinforcing stimulus significantly more often than did the older Ss, and made more pattern responses than the older Ss at the beginning of the task. This difference in the number of pattern responses, however, decreased as the task progressed. Again there was no simple instructional effect, but when pattern responses were considered, the age X instructions interaction was significant. That is, younger Ss in the solution group made more pattern responses than older Ss in the same instructional condition, but for the other instruction groups, older Ss made more pattern responses than younger Ss.

Microfilm $2.50; Xerox $4.00. 71 pages.

A COMPARISON OF THE PERFORMANCE OF RATS AND FISH ON A PROBABILISTIC DISCRIMINATIVE LEARNING PROBLEM

(L. C. Card No. Mic 59-5240)

Ronald A. Weitzman, Ph.D.
Princeton University, 1959

Comparison of the performance of different species presents problems of equating with respect to apparatus and procedure, on the one hand, and to analytical treatment of data, on the other. These problems are not peculiar to comparative studies, but they are especially important in them. The present investigation is a comparative one. We have, therefore, attempted to deal with both these problems.

The Experimental Problem. The objective of this investigation is to compare the performances of two animal forms on two two-choice discriminative learning problems. In one of these problems, both alternative response possibilities may be reinforced, the one 70% of the time and the other the remaining 30% of the time in random sequence. In the other, more conventional problem, only one of the response possibilities may be reinforced, and that one 100% of the time. The two animal forms are the hooded rat and a fish, the African mouthbreeder (Tilapia macrocephala). The discrimination is spatial, going left versus going right.

There has been speculation concerning a possible difference in learning functions underlying different performances of these two forms on the 70-30 problem (Bitterman, Wodinsky, and Candland, 1958). The present investigation was undertaken to demonstrate that perhaps such speculation was premature, that the difference found was due not so much to species differences as to differences in apparatus and procedure.

To this end, we have studied the performances of our animals under both "equated" and "variant" conditions of apparatus and procedure. Under the "equated" conditions, there were minimal food deprivation, no handling of animals between trials, and analogous response requirements for rats and fish. Under the "variant" conditions, there were maximal food deprivation, handling of animals between trials, and response requirements different in detail from those in the equated situation. Five rats and five fish were run in the 70-30 problem under the equated conditions, five rats and three fish in the 100-0 problem under the equated conditions, and five rats in the 70-30 problem under the variant conditions. There were two ten-trial learning sessions daily for 30 consecutive days.

The Analytical Problem. In designing an experiment, we usually attempt to isolate the effect of a single variable. There are many variables in psychological problems, however, which are difficult to control. So, in some of our work, instead of controlling such variables experimentally, we attempt to take account of their effect by appropriate analytical procedures. One variable which is difficult to control particularly in comparative studies is that of individual differences. The usual procedures of equating sub-groups of early and late learners before making statistical comparisons appears to be inadequate. Consequently, we have applied a method of analyzing data in which subgroups are not equated though individual differences are taken into account. This method, involving factor analytic procedures, was developed by Tucker (1958). Essentially, it consists in analyzing learning curves into factorial components much as complex wave forms resulting from sound or heat vibrations are resolved into simpler component sine-wave curves by Fourier analysis. These factorial components, individually or in combination, may represent separate learning processes. By examining the extent to which the performance of animals in various experimental groups is characterized by one or another of these factorial components, we are enabled to draw inferences about the relationship between these groups and the learning process or processes underlying their performances.

The Findings. We may summarize our results as follows: (1) The performances of the 70-30 rats in the variant situation are different from the performances of the 70-30 fish in the equated situation -- a corroboration of the findings of Bitterman, Wodinsky, and Candland (1958); (2) The performances of the 70-30 rats and fish in the equated situation are statistically indistinguishable; (3) The performances of the 70-30 rats in the equated situation are different from the performances of the 70-30 rats in the variant situation; (4) The performances of the 70-30 rats and fish are different, respectively, from the performances of the 100-0 rats and fish in the equated situation. It is especially to be noted that the method of analysis which we used is so sensitive to systematic trends in the data that we were able to obtain a number of statistically significant group differences with only five (or three, in one case) subjects in each group. Consequently, the finding of a far from significant difference between the performances of the 70-30 rats and fish in the equated situation is the more notable. We are, thus, not able to conclude that the fish reach a 70% asymptote and the rats a 100% asymptote under parallel experimental conditions in the 70-30 problem, as has been suggested in earlier work (Bitterman, Wodinsky, and Candland, 1958). We are able to conclude that the learning process or processes underlying the behavior of the animals in our experiment are no different in kind for the rats and fish and that models which predict asymptotic levels of performance of either 70% or 100% are oversimplifications. Microfilm $2.50; Xerox $3.60. 62 pages.

SUBCORTICAL ELECTRICAL STIMULATION IN PRIMATES: DIFFERENTIAL BEHAVIORAL EFFECTS WITH OPERANT CONDITIONING SCHEDULES.

(L. C. Card No. Mic 59-5285)

Peter C. Wolff, Ph.D.
University of Houston, 1959

Statement of the problem. This dissertation was an attempt to study effects arising out of stimulation of different brain areas on two different operant conditioning schedules. The anatomical sites chosen for stimulation were the limbic system, a known region for intracranial reinforcement, and areas of the centrencephalic system of Penfield, known regions for arousal and recruitment effects. The problem studied was a distinction between intracranial reinforcement and intracranial activation in terms of stimulation of limbic and centrencephalic areas and their different effects on operant conditioning schedules.

Method. The first schedule employed was one involving

alternations of 10 minute periods in which the animal could receive self-stimulation by bar-pressing on a variable interval 45" schedule and 10 minute periods of extinction. Days on which extinction alone was presented were interspersed at random for further comparison. Amygdala, central medial thalamic and septal regions were compared by this procedure in one Rhesus monkey.

The second behavioral situation used involved a modification of a schedule developed by Ferster and Skinner in which for one 2-hour leg of the schedule intracranial stimulation was contingent on the bar press on a VI-60" basis and for the other leg of the schedule the intracranial stimulation was imposed randomly at a VI-60" basis independently of bar press. These contingent and non-contingent legs of the schedule were counter-balanced day by day in a contingent--non-contingent day one, non-contingent--contingent day two basis. A comparison of amygdala, central medial nucleus of the thalamus and subthalamic region was made by this procedure in two Rhesus monkeys. A food control was also run within the same subjects. A VI-30" modification of this schedule was also run on one animal to hypothalamic and amygdaloid stimulation.

Results. Effects of stimulation in amygdala and central diencephalic regions produced different behavioral patterns in the two situations. Stimulation of the central medial nucleus of the thalamus produced higher rates during the extinction periods for situation one while amygdala stimulation produced higher pressing rates during the stimulation period. In both cases, the rates were higher than rates on straight extinction days. Central medial stimulation did not produce punishment effects because stimulation rates were near or above rates on days where extinction only was presented.

In the second situation there were significant differences during the first period for each day. There was no significant difference between contingent and non-contingent stimulation response rates during posterior placement stimulation while the contingent rate was significantly higher than the non-contingent rate for the amygdala area stimulation. The food conditions resembled the amygdala area data more closely than the posterior placement. Second period differences were less striking, although the shifts in rates to higher for contingent and lower for non-contingent were greater for amygdala placement than for posterior placement. Food shifts varied for the two animals and made interpretation for the second period results difficult. Acceleration of the variable interval schedule produced a greater increase in contingent rates than it did in the non-contingent rates.

Conclusion. The differences from stimulation for two anatomical placements, the arousal system placements and the limbic placements, were significant for both operant conditioning schedules. The first operant conditioning schedule indicated that central medial thalamic stimulation produced longer-lasting effects than did amygdaloid or septal stimulation. This demonstrates that stimulation of arousal areas of the brain produces longer-lasting effects on behavior than stimulation to reinforcement areas. The schedule involving contingent and non-contingent legs demonstrated that differential effects were obtained clearly under amygdala stimulation and food conditions, while stimulation in centrencephalic areas produced high response rates during both contingent and non-contingent conditions. These results indicate that a different effect from intracranial reinforcement can be obtained with development of new behavioral situations. It is suggested that an elaboration of procedures checking differences between durational effects, contiguity effects and intensity effects of stimulation of different anatomical areas would produce a useful distinction between concepts of intracranial activation and intracranial reinforcement.

Microfilm $2.50; Xerox $5.60. 112 pages.

RELIGION

THE THEOLOGY OF HUGO GROTIUS, JURIST-THEOLOGIAN.

(L. C. Card No. Mic 59-6173)

Winslow Franklin Beckwith, Th.D.
Boston University School of Theology, 1959

Major Professor: Dr. L. Harold DeWolf

No single study of the theology of Hugo Grotius (1583-1645) exists in the English language. Although studies of his theology have been made in Dutch, French and German, there exists no comprehensive presentation of the man and his contributions. Certain misconceptions have marked the interpretation of important aspects of his life and thought. His conclusions with regard to Scripture and doctrine are not all defensible but in his age his method and approach were steps in the right direction. His international law treatises cannot be properly evaluated apart from his theology and Christian piety. They have been treated mistakenly as quite unrelated. His doctrine of the Atonement has been misunderstood. As an ecumenicist Grotius was not pro-Catholic, neither was he Pelagian, Socinian, nor heretical.

The dissertation sets forth within the historical and religious setting the main tenets of Grotius' theology and then undertakes to present his principal contributions. These contributions are in apologetics, doctrine of the Atonement, and the ethics of war and peace.

Hugo Grotius' religious background was liberal Dutch Calvinism. Because political movements and forces were inextricable from religious problems, Grotius studied theology. He promoted the cause of the Remonstrants against the Contra-Remonstrants. On the defeat of the former he was imprisoned. After escape from prison he lived in exile in France serving there as ambassador from Sweden.

Grotius was not a systematic theologian. His writings

were in reply to specific issues and current needs. He believed that the Holy Scriptures were the highest source of truth for man. Truth was also discovered and discoverable by right reason. But Scripture and right reason never contradict one another. The best source for the understanding of Scripture and of Christian faith and practice was the early Fathers of the church.

Certain dogmas preserved in church tradition and continuously reflected in church practice were claimed by Grotius to be essential for Christian belief. Many other dogmas and most religious practices were optional. In his opinions he deliberately chose the via media and expounded these truths in The Truth of The Christian Religion.

Hugo Grotius was an eclectic. He promoted freedom and tolerance. In his search for peaceful settlement or arbitration of disputes between groups or between nations he wrote his pioneering work De Juri Belli ac Pacis, a system of international law consistent -- in so far as Grotius could make it -- with the principles of the Christian religion.

One of Grotius' original and most important contributions was his Governmental Theory of the Atonement, relating the attributes of God's governance to God's atoning work in Christ. Critics of the theory have been misled by Grotius' legal terminology. Such words as "punishment", "divine government", and "acceptilation" must be technically understood when they are used in explaining the Atonement. The word "punishment" does not have the same meaning for God and man; however, the suffering and death of Christ serves in the role of punishment as man sees and understands it. Nor is the term "acceptilation" correctly used by Socinus and others since this legal term does not pertain to administrative justice, as Grotius points out. He argues that a more correct legal term for this aspect of the Atonement is "dispensation". Sin cannot and does not go unpunished. The Supreme Ruler could exact death of every man for his sin. Instead, he accepted the suffering of the Son. This is always the just right of a just ruler. At the same time, the honor and majesty of God's administration were upheld by punishment of sin. As Supreme Ruler God remitted or bore the penalty of sin by accepting the voluntary endurance of penal suffering by his Son.

The dissertation seeks to establish four things. 1) Hugo Grotius succeeded in separating apologetics from dogmatism. 2) He was a competent philologist who became a pioneer of modern Biblical criticism. 3) He argued that men must strive to make law consistent with the teachings of the Christian religion. 4) He released the doctrine of the Atonement from the legalistic confines of medieval feudalism and recovered important aspects which had been neglected or misconstrued.

Although many critics have been misled by Hugo Grotius' legalism, no one could be misled by his positive irenic spirit and deep evangelical piety. He lived and worked as layman. He was a jurist who became a good theologian. Microfilm $2.50; Xerox $8.60. 188 pages.

MORAL CONCEPTS IN TRADITIONAL SERBIAN EPIC POETRY

(L. C. Card No. Mic 59-3091)

Jovan Brkić, Ph.D.
Columbia University, 1959

The historical background and the sources of traditional Serbian epic poetry are discussed in the Introduction, ch. I. In chs. II-VI the concepts of sin, sinning, shame, disgrace, honor, "faith," treason, justice, injustice, vengeance, heroes, heroism, heroic humanity, inhumanity, charity, and freedom are investigated as to their origins, development, and functions within the socio-cultural context where in this epic poetry flourished. The following general conclusion has been reached.

Serbian society from the seventh to the twelfth centuries, up to the foundation of the Nemanjíc State, was a society in transition from its pristine patriarchalism to early feudalism. Some elements of later morality and customary law derive from this period.

The period from the foundation of the Nemanjíc State to its disintegration into successor states in the fourteenth century is marked by rapid development of the state and stratification of the society. The official religion of the state was Eastern Orthodoxy, but among the lower strata of the society some pagan religious practices and beliefs lingered. The literature consisted of translations of Byzantine authors and works composed on Byzantine models. The main instrument of social control was the Byzantine-Roman-Serbian law. Christian morality as preached by the church was the official morality. In addition there undoubtedly existed some kind of folk morality, though nothing definite is known about it. Architecture, represented by the thick network of monasteries, and law were the greatest cultural achievements of the Nemanjíc State.

The period from 1371 to the end of the fifteenth century saw the gradual conquest of the successor states of Stefan Dušan's Empire by the Ottoman Turks. This period was characterized by the regress of political and cultural life in every respect but literature and architecture. In this period of general insecurity the clan in Montenegro and eastern Hercegovina was revitalized and the joint family in other areas was strengthened in order to furnish the protection to individuals which the government was no longer able to provide adequately. With this renewal of the old forms of patriarchal social organization went the development of the customary law, folk religion, and the flourishing of oral literature.

The complex political, social, and cultural conditions which existed during the Ottoman rule were particularly favorable for the flourishing and development of patriarchal forms of social organization and culture, a development which reached its peak in the eighteenth century. This patriarchal culture was a synthesis of pre-feudal, feudal, Christian, and Moslem elements, and new elements which were not only absorbed but modified and further developed by this advanced form of patriarchalism.

The Ottoman State and the Serbian Orthodox church exercised only limited political control over this patriarchal society. The main political control was exercised by the basic political units of the society itself: village organization, and in Montenegro and eastern Hercegovina the tribe, which was a federation of clans. The religion of this society was popularized Eastern Orthodoxy permeated

with Moslem and pre-feudal patriarchal elements. Its literature consisted of the oral epic songs, commonly known as traditional Serbian epic poetry, lyric and mourning songs, stories and proverbs. The main instruments of social control were the morality and the customary law, which were closely related and in some respects identical. The patriarchal morality is represented by moral concepts appearing primarily in the traditional Serbian epic poetry, and to a lesser extent in the other forms of oral literature. The customary law of this society was based on the medieval Byzantine-Roman-Serbian law, though the usage of the medieval legal concepts was modified to suit the needs of the patriarchal society. The morality, insofar as its concepts were not identical with those of the customary law, was a synthesis of some pre-feudal patriarchal elements, a considerable number of elements from the feudal tradition, a small number of Moslem elements, and a large number of new elements introduced to satisfy the needs of the patriarchal society. The preservation, modification, and further development of inherited moral concepts, as well as the introduction of new elements, was almost entirely due to the needs of this society. Only a very small number of the elements of patriarchal morality had no function within it, while with almost no exceptions the moral concepts of the patriarchal society had a definite function within the context of patriarchal morality.

Microfilm $2.90; Xerox $10.00. 222 pages.

THE USE OF BIBLICAL MATERIALS IN THE SERMONS OF HARRY EMERSON FOSDICK

(L. C. Card No. Mic 59-5275)

Elmer Edwin Burtner, Th.D.
Boston University School of Theology, 1959

Major Professor: Dr. Allan Knight Chalmers

This study deals with the relationship between the use of the Bible and the content, structure, and style of Fosdick's sermons. Neither his exegesis nor his theological views, but the sermons themselves constitute the subject matter of this investigation.

Both his ministry and his formal theoretical statements about preaching indicate the fundamentally biblical orientation of his sermons. By filling out an observation schedule for each of the sermons in three volumes, selected as typical of all the published sermons, the necessary data were obtained for a comparison of his theory with his practice. On this basis a critical account of his preaching was constructed.

The theory of preaching has two parts, one a method of interpreting the Bible based on the distinction between abiding experience and changing category; the other (called project preaching) a method of going into sermons by way of the problems and interests of the people. Comparison of the two parts of the theory shows that a concept of experience links them. This concept is developed in several ways. Basically, it is the sensitivity of the dramatist to the interactions of man with God in the arena of common life. By means of dramatic and dominating images drawn from the Bible, and supremely from those associated with Christ, Fosdick seeks to disclose and delineate the structures of man's engagements with God.

Turning from theory to practice, the sermons show the imprint of the concept of experience. The large amount of biblical material together with evident reliance on biblical ideas, even when the Bible is not explicitly cited, shows Fosdick's high appreciation for the value of the Bible in the content of preaching. His ways of introducing Scripture, the types of reference, the linking of ancient and modern experience, the appeals for decision, the handling of categories, all assist in the re-presentation of biblical experience. A characteristic principle of organization, represented chiefly by the repetition of texts, is to "show" repeatedly some one facet or moment of the inter-relations of God and man so steadily and plainly that sight becomes insight for the listener. Certain factors of style--masses of quotations, sentence rhythms, the strong suggestion of dialogue, passages of elevated oratory--can be related to the biblical element in the concept of experience. Indeed, the sermons can be classified according to the type of use made of biblical material, and patterns of organization correlated with the classification, thereby showing the intimate connection between content and technique.

Judging from these observations it is evident that Fosdick did use the Bible quite extensively, and that this use did influence the construction of the sermons so that they would serve to reproduce the biblical witness to the experience of man with God.

Microfilm $3.50; Xerox $12.00. 272 pages.

THE CONCEPT OF JUDGMENT IN THE EPISTLES OF PAUL

(L. C. Card No. Mic 59-5032)

Richard Campbell Devor, Ph.D.
Drew University, 1959

At a time when contemporary theologians and staid Protestant churches tend to evade or eliminate it, the purpose of this dissertation is to investigate the evidence for and the implications of the concept of the judgment of God, limiting the discussion to the epistles of Paul since it is in the epistles where the problem of judgment appears in the most complex and seemingly self-contradictory form.

The concept of judgment in Paul is treated in two general aspects: (1) its cosmic dimension; that is, is there, and in what sense is there, a last judgment on mankind, an ultimate division between the elect and the non-elect, or the saved and the lost, in the light of Paul's declarations concerning the redemptive work of God in Jesus Christ and in view of his several statements apparently suggesting universalism or universal salvation? And (2), its personal dimension; that is, for the individual believer how does the Pauline concept of justification by faith comport with explicit indications of judgment according to, or on the basis of, works? How are justification by faith and judgment by works to be related?

Following two chapters surveying each of these topics as they are treated historically and by contemporary scholars, we investigated the concept of cosmic judgment in the epistles, its terminology, content, extent, and significance, and then placed over against this an exegetical study of the passages suggesting universal salvation or the denial of a last judgment (I Cor. 15:20-28; Rom. 5:12-20; 8:18-25;

Phil. 2:5-11; Col. 1:15-20; Eph. 4:9-10; 1:10), drawing our conclusions in chapter five.

Chapter six investigates the background, meaning, importance, and implications of Paul's concept of justification by faith, emphasizing its opposition to human merit or works righteousness. Chapter seven sets forth, in view of this, the meaning for Paul of judgment according to works, deducing their interrelationship and their soteriological significance, drawing the conclusions of this section in chapter eight.

Results indicate that, with the possible exception of I Cor. 15:20-28, there is in Paul no valid support for universalism, that Paul never, in the course of his letters, altered or reversed his steadfast expectation: that there would be a last judgment of God on all mankind and that only some would be included within the Kingdom of God.

Further, justification by faith is not a peripheral notion to Paul. Rather, justification and all that followed, for the Christian, was a life lived in and through faith. Still, this does not negate judgment on the believer according to works. Investigation reveals that while Paul hinged salvation on faith, and faith alone, he believed that the measure of his reward in the Kingdom, the amount of his recompense, would be determined by the fruits he brought forth from faith. That is, inclusion within the Kingdom, while never insured, was assured through faith and as long as one had faith; but the measure of reward was commensurate to one's works.

Therefore, the study of the Biblical view of history, or Biblical theology, cannot validly expurgate or avoid the concept of the judgment of God and its implicatons for mankind in both its cosmic and personal aspects.

Microfilm $7.00; Xerox $24.20. 552 pages.

THE MESSIANIC HOPE IN THE DEAD SEA SCROLLS AND RELATED LITERATURE

(L. C. Card No. Mic 59-6199)

Cecil Paul Gray, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor J. Philip Hyatt

The Dead Sea Scrolls contain a number of Messianic references which have been interpreted by scholars in a wide variety of ways. The variety of opinion and the fragmentary treatment of this subject seemed to necessitate an effort to obtain a coordinated picture of the teaching of the Scrolls. To get the picture in proper focus, the writer felt that it was necessary to see it in the light of related literature.

This investigation began with a brief review of the Messianic idea in Jewish religion, and an examination of the political and religious background out of which the Scrolls emerged. The ground was thus cleared for an appraisal of the Messianic ideas presented in these newly recovered documents.

All the Scrolls were studied carefully in order to locate those passages that seemed to have Messianic significance. These passages were then analyzed to ascertain what the men of Qumran believed about the subject of Messianism. A conscious effort was made to let the Scrolls speak for themselves, and to avoid reading twentieth-century ideas into them. After extended investigation, some passages were retained as having value for the purpose in hand, while others were discarded. It was found that those passages retained presented at least eight different themes, which are listed thus: (1) the expectation of a change of fortune, (2) a cataclysmic ending of history, (3) an eschatological community, (4) a Messianic forerunner, (5) plural Messiahs, (6) roles of the Messiah(s), (7) titles of the Messiah(s), (8) the superiority of the priesthood.

Because of the extensive use made of the Old Testament by the writers of the Scrolls, it seemed necessary to analyze Qumran's Messianic themes in the light of the central stream of Hebrew-Jewish tradition. Consequently, an effort was made to trace the above themes to their sources in the Hebrew Bible, and to find out if Qumran modified Old Testament thought. It was found that the Messianic expectation in the Scriptures was made up of five ingredients which Qumran appropriated and modified so as to heighten the sense of immediacy. The apocalyptic sections of the Old Testament were seen as the source of Qumran's view of a cataclysmic ending of history, with significant details added by the Covenanters. The desert experiences of the first exodus under Moses, with substantial changes, served as the model for the eschatological encampment in the desert of Qumran. The idea of a coming "prophet" was derived from the Old Testament, but the sect followed later Judaism in the matter of a Messianic forerunner. A singular interpretation of the Scriptures enabled Qumran to see a priestly Messiah standing with, but superior to, a royal Messiah in the "end of days," modifying Old Testament teaching to a marked degree. The roles played by the royal Messiah are much the same as in the Scriptures, with the exception that he is inferior to the Messiah of Aaron. The roles played by the latter were fabrications of minds extremely partisan in their priestly interests. The Scrolls go beyond the Old Testament in their emphasis on the priesthood.

In a comparison of the Messianic themes of the Scrolls with the same, or similar, ideas in the Apocrypha and Pseudepigrapha, many likenesses and many contrasts were found. On the doctrine of expectation they differ only in detail. The same is true concerning a cataclysmic ending of the world. Dissimilarity exists concerning an eschatological community; the Scrolls have a "closed society," but the apocryphal books the opposite. Concerning a Messianic forerunner, both sets of books speak of "a prophet." Some of the apocryphal books envisage two Messiahs similar to what is found in the Scrolls, but most of them see only a Davidic Messiah, if any. The roles played by the Messianic figures show striking similarities, but differ in the idea of a transcendental Messiah. Disparity was found in the titles given the Messiahs in both sets of books. In some apocryphal books there was found the same exaltation of the priesthood that occurs in the Scrolls; however, there was no mention of intrapriesthood difficulties, and but one slight reference to the "sons of Zadok." Microfilm $3.40; Xerox $11.60. 262 pages.

LOVE AND JUSTICE IN THE THOUGHT OF REINHOLD NIEBUHR

(L. C. Card No. Mic 59-5033)

Harry Gordon Harland, Ph.D.
Drew University, 1959

Reinhold Niebuhr's concern has been to clarify the insights and resources of Christian faith in such a way that they may be savingly related to the structures and decisions of large social groups. His central problem has been to delineate the relation between agape and justice. How can a social ethic be derived from agape? A social ethic demands prudent judgment and a concern for the realities of power not heedless sacrifice of self. This thesis is an exposition and interpretation of Niebuhr's thought as it is centred in this problem.

The dialectical relation of agape and justice is central to the whole structure of Niebuhr's thought. Love demands justice. Justice is love making its way in the world of social groups. Love negates justice. Love transcends the calculation of more and less and does not reward according to deserts. Love fulfills justice. Agape, which demands and judges our highest achievements also redeems and thereby fulfills what remains incomplete and distorted by sin.

This understanding of the relationship between love and justice has been at the heart of the major controversies in which Niebuhr has been involved. Some of those discussed are as follows: The debate with those who contend that mutual love rather than agape is the Christian norm; with Brunner and Barth who in different ways weaken or obscure the dialectical relation; with the proponents of Natural Law who give the concept of justice a foundation independent of agape; and with liberal moralism which dilutes agape by assuming that it is a simple historical possibility.

The full impact of Niebuhr's thinking on the relation between love and justice can be discerned only when it is seen as an organic part of his theological, political and anthropological thought. Chapter three is thus given over to a discussion of Niebuhr's understanding of the self and of how the dialectical relation of love and justice corresponds to the Christian view of man in the radicality of his freedom, the radical self-corruption of that freedom, and as at once a creature and a creator of history. Chapter four continues by showing how Niebuhr's view of the relation of love and justice is organic to his theology of history.

Niebuhr's presentation of the Christian revelation not only illumines our understanding of the nature of historical reality, but also he holds clearly before us those resources of spirit which are at once the fruit of faith and the precondition for a responsible approach to concrete issues. It is further contended that his understanding of humility, irony, tolerance, "the nonchalance of faith", and with some qualifications, the church, constitutes a remarkable delineation of the positive resources of Christian faith for the social task.

The Second Part of the thesis is a working out of Niebuhr's theological ethic in the areas of his political and social thought. It contains chapters interpreting Niebuhr's thought on politics, economics, war and peace, and race.

It is the contention of this thesis that the unity of Niebuhr's theological and political thought can be most clearly seen by a consideration of the complex relation between love and justice; but it has been the aim of the thesis to present his thought as a whole.

Microfilm $5.10; Xerox $17.00. 397 pages.

THE TOWN AND COUNTRY CHURCHES OF THE FORT WAYNE (INDIANA) DISTRICT

(L. C. Card No. Mic 59-5279)

Jesse Hill Warwick, Th.D.
Boston University School of Theology, 1959

Major Professor: Dr. Herbert E. Stotts

The purposes of this dissertation began with an attempt to evaluate the Study of the Fort Wayne District of the Methodist Church. The two fields of Sociology of Religion and Church Administration provided methodologies and judgmental criteria. The second purpose was to determine what theoretical implications there were in the Fort Wayne District Study for the Methodist Church in town and country. A third purpose was to evaluate the methodology and implementation of the study. The evaluation of the effect of these methodological procedures upon the institutional structure of the church was a fourth purpose. The fifth and last purpose of the dissertation was to clarify the "total-program analysis technique" as utilized in the Fort Wayne District Study.

The purposes of the study of the District are different from those of the dissertation. The major purposes of the study of the District were as follows: (1) to encourage the laymen of the churches to look at their own problems objectively, (2) to cooperate with other churches in helping to solve them and (3) to seek those solutions which are for the best interests of the Church generally. Problems which faced the District and which were dealt with in the study are those which are facing Methodist town and country churches throughout American Methodism: inefficient administration, lack of ordained ministers, low salaries, and the proper alignment of pastoral charges.

In the Fort Wayne District there are 21 circuits, covering 5 counties, and serving more than 22,000 members. The most striking impression of the District is the small church. Forty-one of the 85 churches on the District have fewer than 100 members.

The District Superintendent of the Fort Wayne District requested that the Department of Sociology and Social Ethics of Boston University School of Theology be responsible for a thorough study of his District. Ministers and laymen of the District worked with the District Superintendent and decided that the study should be undertaken. The study was sponsored not only by the Fort Wayne District but also by the Division of National Missions of the Methodist Church and by the North Indiana Conference Commission on Town and Country Work.

Conclusions drawn in the dissertation are both methodological and substantive in nature. Those in the realm of methodology are stated first.

1. It is possible to use the survey procedure as a catalyst to precipitate lay involvement.

2. It is possible for a scientific study of religious institutions to be conducted by previously untrained lay volunteers.

3. Similarly, ministers without extensive training in the field of research and survey learned through situational analysis at a greater rate than had previously been suspected.

4. Scientific social research need not be expensive.

5. It is possible for laymen and ministers in town and country churches to participate creatively in policy-making procedures at the administrative level.

6. The survey process exemplified in this study of the town and country churches of the Fort Wayne District provides a mirror which a district superintendent can use to perceive his own role, position, status and function in relation to churches of this size.

There are also certain substantive conclusions. These are stated in the concluding paragraphs.

1. The future existence of a church is, to a great extent, dependent on the pyramidal age and sex distribution of its members.

2. In Methodist churches, occupational groupings tend to cluster in modal uniformity.

3. It is more expensive, per capita, to provide partially-trained pastoral leadership on a part-time basis in small churches, than to provide ordained full-time pastors in larger parish groupings.

4. The data indicate that the size of a congregation, however dispersed, which a minister is asked to serve, should range from 300 to 600 persons.

5. Leadership planning should be centrifugal rather than centripetal.

Microfilm $6.45; Xerox $22.20. 504 pages.

SOCIAL PSYCHOLOGY

THE CONGRUENCE OF PAST AND IDEAL SELF CONCEPTS IN THE AGING MALE

(L. C. Card No. Mic 59-6093)

J. Sterling Dimmitt, Ph.D.
The University of Florida, 1959

This study was concerned with demonstrating one effect that profound involvement with the past has on the personality of the aging male of 65 or older. Specific interest was directed toward supporting the observation of Haire and Parsons that the aging male tends to idealize his past. In terms of the language vehicles used, this would mean that the aging male tends to see his past self concept as being congruent with his ideal self concept.

In this study personality was seen as multileveled. The level dealt with here was that of conscious self description. The hypothetical organization of this level was a self structure which consists of a self concept, an ideal self concept, and a past self concept. These constructs were defined as the subject's description of the way he is, the way he would like to be, and the way he used to be, respectively. The most salient characteristic of these constructs is that of temporality—they are concerned with the individual's description of himself in relation to perceived time.

Three groups of 40 males each were utilized. Two groups were made up of normal aging males. The third group consisted of normal young males between the ages of 18 and 35. One aging group was designated the experimental group, and the other was called the aging comparison group. The young group was called the young comparison group.

Each subject described himself on two occasions by use of the Interpersonal Adjective Check List, a list of 128 self-referant words or phrases. Each session was at least four hours apart. Experimental and young comparison group subjects were requested on one occasion to rate themselves as they used to be (past self concept). On another occasion they were asked to rate themselves as they would like to be (ideal self concept). Past-ideal self concept difference scores of the experimental and young comparison groups were contrasted by use of a t test. The experimental group had past-ideal self concept difference scores which were significantly lower than those of the young comparison group.

In order to control for the bias that might be introduced by having the experimental group and young comparison group subjects look back at different segments of their lives when asked to produce a past self concept, the aging comparison group members were asked to describe themselves as adolescents as well as to describe their ideal selves. It had been previously learned that the young comparison group subjects looked back on their adolescence when producing a past self concept. The expectation was that the aging comparison group's adolescent-ideal self concept difference scores would be similar to the past-ideal self concept difference scores of the young comparison group. This expectation was verified.

Results of this study were accepted as demonstrating that aging males tend to idealize their past self concepts. This demonstration was accepted as supporting the observation that aging males idealize their pasts.

It was speculated that aging males are involved with their pasts and that they tend to idealize them because of two major social factors operative in this culture. The first is that our culture is youth-oriented; that is, youth is valued very highly. The second factor is that aging males tend to be respected for what they used to be rather than for what they are.

Microfilm $2.50; Xerox $3.00. 57 pages.

A STUDY OF THE RELATIONSHIP OF SOCIAL CLASS AND OPINION IN RIO DE JANEIRO, BRAZIL.

(L. C. Card No. Mic 59-3142)

Richard Stanislaus Fitzpatrick, Ph.D.
The American University, 1959

This study shows that a group of Brazilians, residents of Rio de Janeiro, conceive of themselves as being on different social strata and that opinions among these three social classes differ on self-satisfaction, human nature generally, education, sex, religion, race, the economic order, freedom, patriotism, conservatism-radicalism, peace and foreigners.

An outline of the importance of Brazil in today's bipolar world and the value of understanding nations in Latin America is followed by a review of the concepts of social class and opinion.

The operational definition of social class used in this study is the individual's response when he is asked whether he belongs to the middle, working, or upper class. Opinion is considered as the verbalization of an attitude. An attitude is defined "as a predisposition to experience, to be motivated by, and to act toward, a class of objects in a predictable manner."

An extensive review of literature on social class and opinion emphasizes some international work done in the field, particularly the UNESCO nine-nation tensions project survey and the primary social attitude scale of H. J. Eysenck.

These reviews of the literature form the basis of 12 hypotheses each of which represents a particular aspect of the overall hypothesis—i.e., that opinions vary with class membership.

Using Brazilian interviewers, an extensive schedule was administered to a sample of 452 Rio de Janeirans. The upper and middle classes were over-represented slightly, while the working class was under-represented. The questions used were taken mainly from the UNESCO survey and the Eysenck scale.

The individual's perception of his own class is found to correspond much more often than not with his income, education and occupation when these are arranged in a three-or four-step hierarchy.

Opinion differences exist between the higher classes (composed of the upper and middle classes) and the working class on a number of questions dealing with human nature, education, satisfaction, sex, religion, race relations and perceptions of foreign peoples.

Although opinion differences exist between the classes on questions relating to the economic order, freedom and patriotism, radicalism-conservatism, and peace, the differences are not clear-cut in terms of the hypotheses suggested.

An attempt to identify social class by the use of a series of 77 social-anthropological statements was undertaken. While there is evidence to suggest that this method of studying social class might be fruitful in Brazil, further experimentation is required.

The study recommends further empirical studies of class and opinion in Brazil.

Microfilm $4.80; Xerox $16.20. 376 pages.

THE EFFECTS OF THREE SCHEDULES OF REINFORCEMENT AND INDIVIDUAL MOTIVATION ON PERCEPTION OF PERFORMANCE AND RISK-TAKING BEHAVIOR

(L. C. Card No. Mic 59-5550)

Elisabeth Ferol Goding, Ph.D.
The University of North Carolina, 1959

Supervisor: Dr. John W. Thibaut

This experiment was conducted to investigate the effects of schedules of reinforcement and levels of achievement motivation on perception of performance and risk-taking behavior. Subjects were informed that they were gradually improving, gradually getting worse or performing at a steady rate at a task which required their separating a series of words into conceptual categories. As proper classification of words was ambiguous, subjects readily accepted the fact that they were performing at rates which were in accordance with the three prearranged schedules. Prior to the experiment subjects, 90 undergraduate males, were classified as having a high, medium, or low level of achievement motivation by means of an objective test.

Subjects were run in groups of three. In the "public" variation a subject was not only informed of his own success record but also was exposed to those of two fellow subjects. In a "private" condition a subject received information concerning only his own performance. Each schedule appeared in each group of three subjects.

During the first 50 categorization trials each subject was asked to estimate the quality of his own and others' performances after each 10 trials and to state his degree of "confidence" in his understanding of the concepts. The subject received 100 points each time he was "correct" and the total number of points, 2500, accumulated at the end of 50 trials was identical for all subjects. Beginning with the fifty-first trial the subjects were required to wager privately some number of his "earned" points before the word for the next trial was seen. All subjects were informed that they were "correct" on trials 51, 52, 60, 61 and 62 and "incorrect" on trials 53 through 59.

The results were as follows:

Achievement Motivation

1. No differences in performance or confidence estimation could be attributed to subjects' level of achievement motivation.

2. Subjects with a low level of achievement motivation raised their wagers after a judgment of "correct," and lowered their wagers after a judgment of "incorrect" relatively more than did those with medium or high levels of achievement motivation.

3. Subjects with a high level of achievement motivation generally wagered less than did those with low or medium levels of achievement motivation.

Schedules

1. All subjects were able to estimate their own performances fairly accurately. Ratings of confidence reflected schedule received.

2. When subjects received no explicit information concerning others' performances, their rating of these others tended to reflect their own schedules. As there

was a tendency to rate others as improving, the finding that those who were informed they were getting worse rated others as also getting worse was interpreted as evidence of a defensive reaction to frustration.

3. Subjects who received the improving schedule made higher wagers than did subjects who received the two other schedules. Subjects who were told they had gotten worse did not make the lowest wagers in the early wagering trials. Some evidence was presented to show that for these subjects the initial experience of doing well may have influenced their later ratings of others. The finding that they made very high terminal self-estimates of performance may again be interpreted as evidence that these subjects reacted defensively to failure.

4. All subjects responded to the reinforcements given in the wagering situation by raising or lowering their wagers after being told they were correct or incorrect. Subjects who received the improving schedule and subjects with a low level of achievement motivation exhibit this behavior to a larger extent than other subjects.

Microfilm $2.50; Xerox $4.40. 82 pages.

Q-METHODOLOGY: A TECHNIQUE FOR MEASURING FRAMES OF REFERENCE.

(L. C. Card No. Mic 59-5359)

Paul Douglass Hood, Ph.D.
The Ohio State University, 1953

The dissertation represents an attempt to explore the use of Q-methodology, a statistical design in which persons are correlated with respect to a series of test or item scores, as a technique for measuring frames of reference in social and in work groups. The dissertation is organized in four sections: (1) a description of Q-method as a research technique; (2) a discussion of two studies employing it; (3) a comparison of the specific methods used therein, with some commentary on the problems involved; and (4) a summary of recent trends in the use of Q-methodology. A series of technical appendices provide explanations of computing short-cuts and IBM procedures developed in the course of the research.

The two illustrative studies include an inquiry into frames of reference of counselors in a university counseling center and an exploration of the attitudes of educators toward anxiety symptoms as these might be manifested by junior and senior high school students.

Introduction

Q-methodology embraces a set of experimental methods or techniques in which persons are compared in terms of their responses to a set of tests or test items. The letter "Q" has been used to distinguish this approach from R-technique in which tests are compared with respect to a set of responses made by persons.

The Q-method, as originally adumbrated by Thomson[1] and Stephenson[2] in 1935, involved the factor analysis of a set of correlations between persons based on test scores. A number of early studies (1935-1939) applied the method in research dealing with aesthetics, reliability of examiners, psychophysics, personality traits, and personal preferences. Recently the method has been applied widely in the study of personality theory and counseling process.[3] These later studies have used a variant of the method termed the Q-sort. In brief, the Q-sort involves a fairly large sample of items drawn from a specified population of items which are sorted into numbered categories along a designated continuum, such as from "most descriptive" to "least descriptive" of some person, situation, or object. Usually a normal or quasi-normal distribution of items is required. The distribution is then correlated with other distributions made by the same sorter following different instructions, or by different sorters following the same or different instructions.

Since there has been considerable controversy concerning the proper use and interpretation of Q-methodology, some of the pertinent issues are discussed in detail under the headings of (1) matrix reciprocity, (2) scaling, and (3) objectivity. The first of these issues pertains to the question of whether the Q-method is logically or statistically different from other methods of dependency and interdependency analysis. The second deals with the nature and analysis of the scores obtained by the method. The third considers the changes sometimes made that the Q-method is a "subjective" technique.

The "O.O.S. Frames" study[4]

The first study reported in the dissertation describes the application of Q-methodology as a technique for measuring frames of reference or biases within a university counseling agency. This study is presented as an example of the use of the technique as a tool for exploring and tentatively defining dimensions of attitude, opinion, interest, belief, and the like which may be held by persons constituting social or work groups. This particular study also illustrates the use of the technique as an "operational research" tool where immediate answers to specific questions concerning practical operations are required.

During a staff conference of the counseling agency, there was a discussion of the types and quality of service rendered. Differences of opinion evidenced during this discussion provided a challenge to attempt an empirical definition of major dimensions of counselor viewpoints concerning the types of service which this agency might provide. This was attempted by:

(1) collecting from the counselors a variety of statements concerning the types of problems presented by clients, either as the client could verbalize them or as the counselor would interpret them;

(2) selecting from these statements a sample of moderate size, i.e., large enough to yield a reasonably small probable error of the sort correlations yet not so large as to make an undue time demand on the sorter.

(3) asking counselors and other workers in the agency to sort these statements in terms of the "priority" they would give to the problem; and

(4) analyzing the relationship among sorts by intercorrelating them and by performing cluster and factor analyses of the correlation matrix.

The resulting study was conducted in two stages. The first stage involved analysis of a dozen sorts by selected personnel of a 60-item "student problems" Q-sort. Results indicated the potentialities of the approach for

providing immediate information relevant to operational problems involving personnel.

In the second stage of the study, the correlation matrix was extended to include sixteen sorters. This involved the majority of the administrative, counseling, clerical, and research staff of the agency. Three "marker" sorts were also included in the matrix. These "marker" sorts were obtained by asking selected individuals to sort the items according to new instructions, based on hypotheses concerning the types of factors which might result from the analysis, namely, "seriousness," "feasibility," and "frequency."

The "seriousness" sort was prepared by a counseling supervisor instructed to sort the cards in terms of their order of importance as possible indicators of clinical problems or personality maladjustment. The director of the agency was asked to provide the "feasibility" sort by sorting the problem statements according to his view of what the agency was prepared to handle. The "frequency" sort was prepared by averaging sorts of two experienced counselors who were asked to sort the cards (independently) according to the frequency with which these problems were encountered as typical of the presenting problems of clients.

The resulting table of intercorrelations of these nineteen sorts was analyzed by the complete centroid method using an experimental IBM procedure. Four orthogonal factors were extracted and rotated to conform with the "marker" sorts.

Factor I tended to define a dimension of common agreement among sorts as to the kinds of problems which should receive "priority." The frame of reference represented by this factor is one involving evaluation of the problem in terms of the general objectives of the agency and the capacity of the agency to handle such problems.

Factor II defined differences among counselors with respect to the frames of reference used in evaluating personal adjustment problems, in contradistinction to occupational planning problems. Examination of the patterns of loadings of individual counselors on Factors I and II suggested that two clearly distinguishable types of counselors could be identified in the agency; both types tended to agree on the general importance of vocational counseling, but they gave a different interpretation of aims, content, and purposes of such counseling. The one type tended to emphasize client problems involving general adjustment in preparing for and selecting a means of making a living; the other type tended to stress the more immediate and situational aspects of personal orientation and occupational planning.

Factor III defined a difference of opinion and interpretation between counselors and noncounselors on what should be handled by the agency and what should be referred to other university agencies. This difference of opinion may be traced to a less adequate orientation concerning the purposes of the agency and to less information concerning student services available at other campus agencies on the part of the noncounseling staff.

Factor IV accounted for another frame of reference used almost exclusively by non-counselors in making their sorts. Essentially, it is a bipolar dimension of special interests and sympathies marked on the one end by a tendency to give priority to problems of a personal nature, and on the other by a tendency to give priority to academic and financial problems connected with remaining in school.

In the discussion of this study, the dissertation treats theoretical and practical problems related to the interpretation of the findings including the matters of reliability, validity, and implications for use by the agency.

The Anxiety Symptoms study

The second study reports an attempt to use Q-methodology to examine the concept of "anxiety" as it is used by educators and other professional workers in considering isolated behavior descriptions applicable to anxious or maladjusted junior and senior high school students. This study was action research in that it was employed primarily to introduce ideas and attitudes of thinking about "anxiety" in experimental terms. The report is a by-product of this primary aim.

Studies of teacher assessment of pupil personality by Wickman,[5] Mitchell,[6] Ellis and Miller,[7] Thompson,[8] Ullman,[9] and Ives,[10] are relevant to the content of this study and, in general, are more extensive in their treatment of substantive findings. The emphasis here has been upon the method.

The plan of the study called for selection of 100 behavior description items from a collection of statements made by teachers during interviews in which they were requested to describe specific behaviors of children whom they had known and labelled "anxious." These 100 items were categorized under ten broadly defined behavior groupings: (1) physiological or psychosomatic symptoms, (2) social withdrawal, (3) social aggression, (4) approval seeking, (5) evidences of personal conflicts, (6) rejection of academic responsibilities, (7) academic status seeking, (8) evidences of academic deficiency, (9) problems of self-orientation, and (10) lack of emotional control.

Sorters were instructed to sort cards containing the behavior statements into a ten pile forced distribution according to the intensity of anxiety which the behavior might indicate.

Sorts made by 38 persons, including teachers, social workers, psychologists and psychiatrists, were intercorrelated and factor analyzed. Scores were also combined and analyzed for two groups of teachers, a group of social workers, and a group of psychologists.

Analysis of correlations between group totals indicated that an order of significant common agreement existed among all four groups, but that agreement was much stronger between some pairs than others. Greatest common agreement between groups was found on items which had been categorized as Emotional Control, Self-orientation, and Social Approval.

The low individual intercorrelations precluded entertainment of any hypothesis concerning a high order of agreement on the nature of anxiety symptoms, at least as expressed by the Q-sort items. A multiple group factor analysis yielded ten factors, accounting for 53 per cent of the total variance. In general, the factors seemed to have much in common and were not too clearly defined. One of the most clear-cut factors (Factor X: Rejection by Peers vs. Rejection by Adults) defined anxiety in terms of difficulty in peer relationships, signs of inner conflict, and physical symptoms. Here, the less anxious person is perceived as one manifesting excessive worry and preoccupation with self in ways unacceptable to adults, one whose behaviors are indicative of unsuccessful internalization of anxiety. The sorter frame of reference appeared to be that of the "modern" educator, defining anxiety more or less psychiatrically.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The nine other possible frames of reference were labelled:

Rebellion Against Authority vs. Seeking Adult Approval;

Physical Manifestations vs. Social Inadequacy;

Regression vs. Rebellion;

Interpersonal Conflict vs. Self-conflict;

Insecurity Manifested in Teacher-Pupil Relationships vs. Insecurity Manifested in Other Relationships;

Failure to Meet Teacher Demands vs. Failure to Meet Peer Demands;

Irresponsibility toward School Work vs. Worry about Social Status;

Lack of Ability to Maintain Emotional Self-Control vs. Attempts to Acquire Control; and

Poor Group Member vs. Preoccupation with Self.

No consistent trend for a particular group to load differentially on any of the above factors was identified. It was thus concluded that, with few exceptions, sorter frames of reference varied considerably and that, paradoxically, there was a considerable amount of common agreement between the groups, but a pronounced lack of agreement among individuals.

Following the presentation of the "O.O.S. Frames" and the Anxiety Symptoms studies, problems commonly encountered in Q-sort experimentation are discussed and illustrated by reference to the two studies. The problems discussed include (1) problem definition, (2) item development, (3) sort preparation, and (4) analysis. The concluding chapter contains brief comments on recent trends in Q-methodology.

A series of technical appendices provide an account of the various IBM adaptations which were applied to Q-methodology statistics: (1) an automatic method for scoring Q-sorts, (2) a method for computing the numerator of the correlation equation, and in special instances, the correlation itself, (3) a series of methods for performing a number of statistical operations involved in the factor analysis of the intercorrelations, (4) two methods of "scoring" items as a means of identifying the content of Q-factors, (5) a method for approximating "pure Q-factor" sorts, and (6) a practical method for scoring Q-tests.

Microfilm $2.70; Xerox $9.40. 206 pages.

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3. See Mowrer, O. H. "Q-Technique—Description, History, and Critique," in Psychotherapy Theory and Research, ed. by Mowrer, O. H., New York: Ronald Press, 1943, pp. 316-375.

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Abstract published by special arrangement with The Ohio State University.

CERTAIN SOCIAL-PSYCHOLOGICAL ASPECTS OF TYPES OF JUVENILE DELINQUENTS

(L. C. Card No. Mic 59-5464)

John Willard Kinch, Ph.D.
University of Washington, 1959

Chairman: Clarence C. Schrag

Ratings of thirty adjectives were made by forty-nine delinquent boys who were committed to a diagnostic center for institutional assignments. Using the thirty adjectives each boy (1) rated himself, (2) rated the way he thought his "best friend" would rate him, and (3) rated the way he thought his cottage supervisor would rate him. In addition, the boy was rated by (4) his best friend, and (5) his cottage supervisor.

The boys were then classified into types according to certain constellations of background variables derived from the literature. The four types analyzed were labeled "the pro-social delinquent," "the anti-social delinquent," "the a-social delinquent," and "the non-social, neurotic delinquent." In addition, a number of boys who did not fall into one of these types were considered. The primary goal of this dissertation was an analysis of these types of delinquents in terms of the self-conception items mentioned above.

A comparison of the mean ratings on the adjectives for the individuals in each type produced indications of the content of the self-concept, the perceived responses of others, and the actual responses of others towards the boys in the type. By comparing responses on the five forms of the rating scales it was possible to obtain measures of (1) role-taking ability, (2) the degree to which the individual uses the other as a significant reference, and (3) social visibility. These measurements were analyzed in terms of their relationship to the various types of delinquents.

The thesis describes each type in some detail in terms of the results of the analysis suggested above. The findings are, for the most part, consistent with the expectations gained from the review of the literature on this subject.

After the typology that was constructed proved useful as a heuristic devise it seemed reasonable to perform a more formal test of our hypothesis that homogeneous ratings would be obtained from boys with similar constellations of background variables. This was tested by the use of inverse factor analysis. Two analyses were done, one using all the subjects and a second using only those who fit best into the background types. Both analyses failed to give convincing support to the hypothesis. A third inverse factor analysis examined the data for a simple structure. These findings also failed to produce fruitful results.

It is felt that the present research is suggestive of a useful typology, but the relevant variables are not yet sufficiently clear to prove the typology by use of factor analytic procedures.

Microfilm $2.50; Xerox $8.40. 185 pages.

COGNITIVE COMPLEXITY AND CONFLICT RESOLUTION IN IMPRESSION FORMATION

(L. C. Card No. Mic 59-6191)

Clara Alexandra Weiss Mayo, Ph.D.
Clark University, 1959

Supervisor: Walter H. Crockett

Problem: Recently, there has been increasing interest in the area of psychological investigation dealing with impression formation. The present study derives from a theoretical orientation which assumes that individuals develop a system of concepts by which they order their experiences with other people and make predictions about their behavior. G. A. Kelly and others have dealt with the effect of the nature of a subject's cognitive system on the impressions formed, especially in terms of the accuracy of the predictions made. Other investigators have experimented with the effect of conflicting information about a person on the impression formed of him. This study is designed to explore how persons differing in the number of concepts they have about others (cognitive complexity) form an impression of a person when presented with both positive and negative information about him. The resolution of the conflict involved is presumed to take different forms in subjects of high and low cognitive complixity. It was hypothesized that people with high cognitive complexity will have less univalent impressions of a person about whom multivalent information is given than will those with low cognitive complexity; and that less change in the impression would be produced among subjects with high cognitive complexity by the addition of the conflict-producing information than among subjects with low cognitive complexity.

Subjects: From 80 undergraduates at Clark University two experimental groups were selected with 18 subjects of high cognitive complexity and 18 subjects of low cognitive complexity. These groups were matched for sex and intelligence.

Procedure: A modification of Kelly's Role Construct Repertory Test was used to determine cognitive complexity. Subjects selected from their own acquaintances eight different persons to fit social role titles presented by the experimenter. The subjects then compared and contrasted these persons in groups of three by listing the ways in which two persons felt, thought or behaved alike and different from the third. Subjects were rank ordered in terms of the number of different concepts they used and the two experimental groups were selected from the extremes of this distribution.

After hearing a tape recording in which two men and two women gave a univalent (either positive or negative) description of a young man, these subjects wrote a short description of him, predicted his behavior in situations of ethical conflict, rated him on paired opposing traits, and stated whether they believed him to be real and normal. Subjects then heard a tape recording in which four other people described the same young man as having traits opposite in valence to those in the first recording and made the same judgment of the man. The order of presentation was varied within both experimental groups.

Results: The descriptions written by the subjects showed no significant difference between high and low cognitive complexity groups in the number of positive and negative traits mentioned after hearing only univalent information and after hearing both positive and negative information. However, subjects with low cognitive complexity changed their impression more than did those of high cognitive complexity. This trend was especially evident in the more structured tasks. The difference between experimental groups in the extent to which their judgments changed upon presentation of multivalent information was significant at the .001 level for predictions of behavior in ethical conflict situations and significant at the .05 level for choice of traits.

The effects of the order of presentation of the information, of the sex of the subjects, and of interactions among these and the experimental variable of cognitive complexity were tested and found not to be significant.

The results seem to justify the view that it is possible to find systematic differences among people in the number of concepts they use in forming impressions of others and that these differences affect their ability to form an integrated impression of others when presented with both positive and negative information about them.

Microfilm $2.50; Xerox $4.80. 95 pages.

EGO-INVOLVED JUDGMENTS AND SOCIO-DEFINED SEX ROLES

(L. C. Card No. Mic 59-5496)

Albert Tennyson Milam, Ph.D.
The University of Oklahoma, 1959

Major Professor: Dr. Henry Angelino

Problem

This study is an investigation at the psychological level of a problem in intergroup relations that was previously studied at the sociological level.

In the sociological study it was found that the group norms which define Negro-white relations in the United States culture also permit considerably more freedom for the feminine role of the Negro woman than for the masculine

role of the Negro man. This difference has appeared least in the area of religion and most in the political and economic areas.

Related historical, sociological, psychiatric, and psychological research indicated that the above group norms encompass principally the existing stereotypes of the Negro. These stereotypes are essentially embodied in the "separate but equal" doctrine and implied in some of the judgments expressed by a number of people in everyday life regarding the segregation-integration issue.

The purpose of this study was to validate the sociological findings by determining whether or not the subjects would manifest the sex difference when judging an anti-"separate but equal"-pro-family issue which could be approached from the standpoint of religious, political and economic values.

The main prediction was that the females would select the political and economic approaches to the issue significantly more frequently than would the males.

Method

One hundred and thirteen Negro adolescents (70 females and 43 males) were presented 12 stimulus cards containing issue statements which were introduced by key words used in the descriptions of evaluative attitudes in the 1951 edition of the Study of Values manual by Allport, Vernon, and Lindzey, and a sheet of statements clarifying the values.

Each subject was asked to select three cards containing ideas that were most important for solving the human problems which were judged to come first in importance.

Findings

The major selection patterns found are as follows: (1) The females selected the following two patterns significantly more frequently than did the males: the religious, social, political and economic (p .01); and the religious, social and political (p .025). (2) There was no significant difference, however, between females and males in selecting the religious, social and economic (p greater than .05).

Conclusions

It was concluded that these findings indicated (1) significantly greater ego-involvement of the females than the males in the first two selections indicated above; (2) essential confirmation of the main prediction; and (3) indirect confirmation of the main sociological finding.

Microfilm $2.50; Xerox $4.60. 87 pages.

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN COMMUNICATOR STIMULI AND PRESTIGE SUGGESTION

(L. C. Card No. Mic 59-6651)

Paul William Thayer, Ph.D.
The Ohio State University, 1954

The study of opinion change has a long history probably because of its practical implications. People in responsible positions are constantly being confronted with the problem of communicating their ideas to others and are much concerned with the effectiveness of these communications. Employers want to know how to get information to modify their employees' attitudes toward company policies and practices. Educators are concerned with similar problems. Today, nations engaged in ideological warfare want to know if their propaganda are effective. In addition to those interested in these practical problems, there are a number of investigators engaging in communications research who are concerned with building a theoretical model which will help in understanding the process by which an individual acquires, maintains, and modifies his opinions. The present investigation is a further attempt to define more precisely the nature of the process which underlies opinion change.

Previous research in the field of opinion change has dealt with characteristics of the individual attempting to induce an opinion change, characteristics of the audience, and characteristics of the communication dealt with the use of various media such as lectures, radio addresses, and motion pictures. The effectiveness of emotional and rational appeals has been studied, as well as the effectiveness of fear-arousing appeals, humor, one- and two-sided arguments, and ambiguous stimuli. All of these media and techniques have been successful in inducing opinion changes under one conditions or another.

Studies of prestige and majority suggestion, which would be included under investigations of the characteristics of the individual inducing an opinion change, have shown that either of these sources can be effective in inducing an opinion change. When compared with each other, we find that the former is more effective when the topic being judged is fairly technical, while the latter is more effective when the topic involves judgments concerning social norms.

A number of investigators have attempted to study the characteristics of the audience. Thus we find attempts to relate such variables as body type, intelligence, sex, and age to opinion change. Studies of these variables have met with mixed success and have yielded contradictory results. More recently, attempts have been made to identify the various motives which may mediate the process of opinion change. This particular approach appears to be more successful than the former.

The purpose of the present research was to investigate the relationship between communicator stimuli and opinion change. Specifically, the writer was interested in determining whether individuals who indicated that they possess positive attitudes toward status will be more likely to change their opinions when presented with a communication from a prestige source than will individuals who do not possess such attitudes. Corollary problems dealt with the relationship of the learning of the content of the communication to opinion change, as well as the relationship of other variables, such as age, sex, job experience, and knowledge of the field dealt with in the communication, to opinion change.

PROCEDURES

The Hepler Labor Attitude Scale, the Seeman Status Attitude Scale, a Biographical Inventory and the Occupational Attitudes Rating Scales were administered to 356 elementary psychology students at The Ohio State University. Three weeks later, 164 of these participated in the

experimental and control portions of the study. All four experimental groups were tested to determine their knowledge of labor and union affairs. Immediately following this, they were exposed to a tape-recorded, pro-labor address. For two of the experimental groups, this communication was presented by a (fictitious) noted authority in the field of labor-management relations. The other two experimental groups were told that the address was made by a college senior. One group exposed to the high prestige figure (the authority) and one group exposed to the low prestige figure (the college senior) were told that the speaker would appear personally following the address. The other two groups were told nothing.

Immediately following the address, the Labor Attitude Scale was readministered. Next a short questionnaire was given to obtain the audiences' reactions to the communicator and the address. To check on the possible differential learning of the content of the communication when presented by the two communicators and its effect upon opinion change, a recall test was then given which covered the main arguments and evidence offered in the address.

The control group took the Labor Attitude Scale, the Status Attitude Scale and the Occupational Attitude Rating Scales for the second time, and also took the test of the content of the address for the first time. Having the control group take the Content Test even though not exposed to the communication served to check on the validity of this instrument.

Opinion change scores were derived by subtracting the pretest scores from the post-test scores on the Hepler Labor Attitude Scale. All data were analyzed for the various groups for the purpose of testing hypotheses concerning: (1) the perceived differences in the qualifications and fairness of the communicators; (2) the perceived relatedness of the issues raised to the topic of the address—"Unions and Industrial Democracy"; (3) perceived opinion change; (4) differences in the number of individuals changing their opinions in a pro-labor direction under the four experimental conditions; (5) the effect of differential learning of the content of the address upon opinion change; (6) the relationship of measures of attitudes toward status and prestige symbols as measured by the Seeman Status Attitude Scale, the Achievement Drive scale of the Occupational Attitude Rating Scales, and participation in various collegiate activities to opinion change under the different experimental conditions; and (7) the relationship of nonattitudinal individual characteristics, such as intelligence and knowledge of the field, and demographic variables to opinion change.

RESULTS

1. The communicator who was introduced as an authority in the field of labor-management relations was perceived as being significantly better qualified to speak on this topic that was the communicator introduced as a college senior.

2. No differences were obtained among the four experimental groups with respect to the perceived relevance of the issues involved in the topic of the communication, "Union and Industrial Democracy."

3. The promise of a personal appearance of the high prestige communicator raised the audience's evaluation of his fairness significantly.

4. The promise of the personal appearance of the high prestige communicator also raised the audienc's evaluation of their own degree of acceptance of his pro-labor recommendations.

5. An analysis of variance revealed that all experimental and control groups were matched on the basis of initial scores on the Labor Attitude Scale.

6. An analysis of covariance of pre- and post-test scores on the Labor Attitude Scale revealed no significant differences between the experimental and control conditions presumably because of the marked heterogeneity of the sample. Accordingly, opinion change scores were computed by subtracting the individual pretest from the post-test scores on the Labor Attitude Scale and cutting scores were assigned for the purpose of comparing the number of individuals making marked changes in the recommended direction.

7. The number of individuals in the two high prestige groups changing their opinions in the pro-labor direction by any amount was significantly greater than in the control. No differences were found between the low prestige audiences and the control in this comparison.

8. The number of individuals showing a marked opinion change was significantly greater in all experimental groups (high and low prestige) than in the control.

9. The promise of the communicators' appearance had no effect on the actual change scores of the audiences involved.

10. No significant differences were found among any of the experimental groups with respect to recall of the content of the communication. All experimental groups, however, scored significantly higher on the recall test than did the control group which was not exposed to the communication.

11. Three measures, participation in extracurricular activities, holding offices therein, and the Achievement Drive Scale of the Occupational Attitudes Rating Scales, were positively related to opinion change scores for the combined low prestige groups. They appear to reflect positive attitudes toward participation in and gaining recognition from collegiate life and its activities. These measures were not related to opinion change for the combined high prestige groups.

12. The Status Attitude Scale was positively related to measures of opinion change for the combined low prestige groups, but it was not so related for the combined high prestige groups. The lack of relationship found between positive attitudes toward status and opinion change under prestige suggestion in this case probably resulted from the inverse relationship found between positive attitudes toward status and pro-labor attitudes found in the two high prestige groups.

13. Participation in fraternities or sororities, offices held therein, evaluations of the speaker and the communication showed little relationship to the criterion of opinion change. While it would appear that participation in fraternities and sororities and participation in activities should be related and should reflect positive attitudes toward recognition gained from participation in collegiate life, these variables showed only a low relationship.

14. Intelligence, knowledge concerning the field of labor-management relations, number of jobs held, scores on the Economic scale of the Occupational Attitudes Rating Scales, attitudes toward strictness of parents, the subject's class rank and number of quarters in college, the subject's age and sex, and parents' education and occupation were all unrelated to opinion change scores.

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CONCLUSIONS

Much of the previous effort in the field of communication research has been directed at investigations of the types of arguments and appeals used in propaganda, the subject's attitudes toward the topic of the propaganda, the speaker's trustworthiness and the characteristics of the individuals who change their opinion as a result of suggestion. The principal purpose of the present research was to investigate the role which the communicator plays in inducing an opinion change and the relationship of communicator stimulus characteristics to the attitudes of the audience.

The basic theoretical orientation offered here is that before an individual will change his opinion with respect to a given object or subject, he must be motivated to do so. The motives which mediate such a change will vary from individual to individual and from one communication situation to another. The writer assumes that the various acquired motives of the individual which would motivate such a change depend upon stimuli for their arousal. Thus, while an individual may possess positive attitudes toward status, these would not be aroused unless the stimuli toward which these attitudes are directed are present.

On the basis of this assumption, the writer would predict that a status-seeking individual who is presented with a communication from a status figure would change his opinion because of the arousal of this particular motive. If the individual does not possess positive attitudes toward status, other things being equal, the writer would predict that he would not change his opinions concerning the subject matter area covered by the communication. Other factors, of course, such as those mentioned in the first paragraph of this section, will complicate the picture. It seems reasonable to assume that the communicator does play this motive-arousing part in opinion change.

The hypothesis offered and refuted elsewhere under different conditions, that positive attitudes toward the communicator have the effect of increasing the attention of the audience and thereby increasing the learning of the arguments supporting an opinion change, is again refuted here. We find no significant differences in the recall scores of the high and low prestige groups despite the fact that a significantly greater number of individuals in the high prestige group changed their opinions in the proper direction than was the case in the low prestige audiences. Subsequent analysis which compared those who made a marked opinion change as opposed to those who did not reveal correlations with recall test scores of 0.09 and -0.13 for the high and low prestige groups respectively. As neither of these correlations is significant, we may conclude that the difference in the two communicators had little effect upon the learning of the communication content. Thus, the function of the communicator under these conditions does not appear to be one of attention-getting with a resulting increase of opinion change because of greater learning of the arguments presented.

The present research supports, to some extent, the general thesis proposed as to the role of the communicator in inducing an opinion change. The writer finds that when a college senior makes the address, instruments tentatively identified as measures of attitudes toward recognition gained from collegiate life and activities are positively related to opinion change. This would seem to support the hypothesis that positive attitudes which mediate opinion change are aroused by the communicator. At the same time, scores on the Status Attitude Scale are positively related to opinion change in the low prestige group. This, plus the high evaluation of the speaker's qualifications made by the audience and the fact that he is supposedly making a radio address, might be interpreted as resulting from the arousal of the audience's status-seeking motives.

The fact that none of the variables identified as measures of attitudes toward collegiate activities is related to opinion change under high prestige suggestion supports our analysis also. The communicator stimuli are such as to be unrelated to these attitudes. The communicator is an authority in the field, author, lecturer, and labor mediator. We would expect that opinion change scores would be related to positive attitudes toward status, in as much as the communicator certainly possesses numerous high status characteristics. The lack of relationship found for the high prestige audiences has been interpreted here as the result of the negative correlation (-o.42) between pro-labor attitudes and positive attitudes toward status. Apparently some of the status-seeking individuals are motivated to accept what the communicator recommends — a shift in opinion in favor of unions. Others, however, may either reinterpret what he says to fit into their already held anti-labor attitudinal system, or may suspect the communicator's motives or actual existence and thereby make possible the maintenance of their anti-labor attitudes. The net result of these different reactions to the communicator is to reduce the expected positive relationship between status attitude scores and opinion change scores under high prestige suggestion to zero. This interpretation, of course, should be tested by further research involving a change in the direction or topic of the communication. Under these conditions of congruence of attitudes toward the communication and the communicator, we would expect a positive relationship between opinion change and status attitudes.

The lack of relationship of the other individual and demographic variables to the criterion serves to highlight the fruitfulness of the present approach. Rather than deal with relatively static variables such as age, sex and the like, it appears more profitable to examine the communicator stimuli, the content of the communication, and the motivational variables operating in the situation. This approach should yield sufficient data for an adequate theory of communications.

Microfilm $2.50; Xerox $6.60. 139 pages.

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SOCIOLOGY, GENERAL

SOCIAL STRUCTURE AND PERSONALITY: THE CONTRIBUTION OF ERICH FROMM TO SOCIOLOGICAL THEORY.

(L. C. Card No. Mic 59-6428)

William Daughety Amis, Ph.D.
The University of North Carolina, 1959

Supervisor: Rupert B. Vance

The purpose of this dissertation is to demonstrate the need in general sociological theory for a theory of social psychology and to show the value for sociological theory of Erich Fromm's social psychology. The explanation of compliance with social norms is chosen as the focus of the dissertation since this problem illustrates the need for a theory of social psychology as a component part of a general sociological theory. The social psychology of Pitirim Sorokin's systematic sociological theory is analyzed and its inadequacies demonstrated.

A review of Erich Fromm's social psychological theory is presented, including his theory of personality, his typology of character, and his theory of the interrelationships of personality and social structure. Fromm holds that the sociocultural organization of a society creates problems for participants in the society which influence the quality of interpersonal relationships generally, including relationships within the family. The peculiar quality of relationships common to families in a given society or social group tends to produce in the offspring of these families character structures which are relatively inflexible and which are in certain respects standard for members of that society or group. These "social character" traits, as they are called, have the function of supporting the particular kind of social relationships which are required for the maintenance of that society's social system. They do so by "internalizing external necessities" so that the individual "wants to do what he has to do" from the standpoint of maintaining the social system. Under certain conditions, the normally congruent relationship between social character and social structure is disrupted. This creates strain in the personality structure and evokes defensive reactions which intensify the individual's need for a solution to the crisis. Consequently, he becomes more vulnerable to new ideologies or social movements. In this manner the social character may become a force for social change.

It is concluded that a theory of social psychology which serves to relate a theory of personality to the theory of the social and cultural systems is an essential component of any systematic sociological theory which is adequate for dealing with all varieties of problems of sociological interest. It is shown that a theory of personality is essential to an adequate explanation of why men comply with social norms. Specification of the conditions under which compliance takes place is basic to the problem of why social systems persist and why, under certain conditions, they change. It is Fromm's theory that most individuals in a given society or group develop character structures whose nature is such that performance of socially required behavior is for them psychologically gratifying in itself, apart from social rewards and punishments. Strain is especially great, on the other hand, when the character structure is not congenial to the behavior required by the social structure.

Fromm's theoretical model provides for the delineation of the personality, the culture, and the social system as distinct systems. They are irreducible to each other, for each has principles of organization and functioning peculiar to itself, though at the same time the three systems are functionally interdependent. In his substantive analyses, Fromm illustrates the utility of shuttling constantly among the three systems, analyzing the repercussions in each of what is happening in the other systems. Fromm's theory is the most useful theoretical model that has thus far been developed and applied to the analysis of the role of personality in the maintenance and change of the social system of a large, complex modern nation. Since his theory does not include an adequate conceptualization of the social system or of the cultural system, however, it must, for optimum value, be used in conjunction with existing systematic sociological theories.

Microfilm $3.85; Xerox $13.00. 298 pages.

OCCUPATIONAL IDEOLOGIES AND PROFESSIONALIZATION IN SOCIAL WORK

(L. C. Card No. Mic 59-5508)

Reba Muriel Bucklew, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Vernon J. Parenton

This study in the sociology of occupations is concerned with occupational ideologies and professionalization in social work. Sociology is a general science, but the focus in sociology may be a specific one. The importance of occupations as a means of social classification and differentiation is recognized by sociologists. The two specific purposes of this study are: (1) to examine the degree of professionalization in social work and (2) to analyze occupational ideologies in the social work subculture which influence the prestige, authority, and monopoly of social work as a profession. Statistical and typological procedures are employed in the analysis of the two-fold problem. The examination of the degree of professionalization in social work is based upon a survey of scientific and professional literature in the fields of sociology and social work. The empirical analysis is based upon data gathered by the questionnaire method. One hundred and thirty-two persons representing the entire population of two groups of social workers in Dallas, Texas, participated in the study.

Social work is a profession with a systematic body of theory upon which its practice is based; it has received some community sanction through a plan of voluntary certification; it exercises professional authority and has developed norms of professional behavior set forth in a code of ethics which regulates professional-client relationships, colleague relationships, and relationships to the agency and community.

The self-image of social workers reveals that they are convinced that social work ranks high in its power to help

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others. The prestige of social work is middle range in the general occupational hierarchy and low in the professions. The prestige level of social work in the hierarchy of professions is less clearly positioned among social workers themselves. Social workers, in general, are primarily of middle-class background according to their own self-estimate of social class identification. This classification is influenced by the size of the community in which the worker was reared and the types of association as well as income and occupation.

The boundaries of social work as a profession are not well established. Data in this study imply that social work is not ready to give up some of its broader areas of service and assistance for the sake of a narrow technical competence. There is evidence that the desired educational attainment for social workers exceeds the actual training of the workers now employed.

Social work is not a free practicing profession, and it operates in a wide range of agency and organizational settings, and the individual's self-image of the social worker is often threatened in some settings.

Specialization adds to the confusion of the structural and functional aspects of the social work positions. Social workers are strongly motivated in the choice of social work as a profession because of its enabling process and problem-solving service.

The movement toward professionalization in social work is complicated by the conflict in norms and ideologies of its own subculture and those of the general culture: humanitarianism versus technical competence; traditional sex roles versus new professional roles; the middle class standards of social workers versus the variation of social background of clientele; and "rugged individualism" versus social responsibility. The process of professionalization is complicated by the middle range occupational prestige of social work which is in conflict with social workers' firm belief that their profession ranks very high in the power to help.

Microfilm $5.05; Xerox $16.80. 393 pages.

ATTITUDES TOWARD LEGAL AGENCIES OF AUTHORITY FOR JUVENILES: A COMPARATIVE STUDY OF ONE HUNDRED THIRTY-THREE DELINQUENT AND ONE HUNDRED THIRTY-THREE NON-DELINQUENT BOYS IN DAYTON, OHIO

(L. C. Card No. Mic 59-5353)

Ames Waudell Chapman, Ph.D.
The Ohio State University, 1953

In the last three decades workers in the correctional field have been placing increasing emphasis upon the child's conception of his place in society in general and in his own group in particular. This represents a distinct trend away from those concepts which focussed the major part of their attention upon the individual per se. There is an increasing body of fact and theory which centers its attention for the most part on the individual in the group and on the attitudes he holds toward those who represent authority. The effect of cultural and social factors on the development of attitudes and values is stressed.

A boy's attitude toward a policeman, the juvenile court, probation, detention, or a training school may be of great significance in determining whether he will be a law-abiding citizen or not. Delinquency prevention, is apparently dependent to a great extent upon the juveniles having friendly attitudes toward the legal agencies of authority. These might be achieved by restructuring either the values of the boys or those of the legal representatives of juvenile authority. It is one of the major functions of society, in general, and of the police, juvenile court, and probation officers, in particular, as the branches of society with the greatest legal influence over adolescents, to set the stage for the development of wholesome attitudes toward legal authority and thus facilitate a reduction in the volume of delinquency. It is of primary importance, then, to recognize those children whose attitudes toward legal agencies of authority for juveniles are not proceeding along satisfactory lines.

This study was undertaken to meet this need. Its purpose was to investigate the attitudes of nondelinquent and delinquent boys toward legal agencies of authority for juveniles and to determine the extent or degree of difference in their attitudes. Stated more specifically, the purpose of this study was to investigate whether non-delinquent boys had more favorable attitudes toward the police, the juvenile court, probation, detention, and the Boys' Industrial School than a group of delinquent boys matched for age, number of years completed in school, race, intelligence, occupation of father, and residence.

METHODOLOGY

In the construction of the instrument to be used to measure the attitudes of the boys, over 250 items were collected from such sources as other studies, case histories, spontaneous statements from boys in a group, and competent authorities in the field of corrections. One hundred seventy-four of the 250 items collected were placed in the form of a test and administered to 160 boys in Springfield, Ohio. Of the 160 boys, 40 had been handled officially by the Juvenile Court. The boys ranged in age from 13 to 17, with a mean of 14.7. The range in grade was from 7 to 11, with a mean of 9.3.

The Likert[1] method of scoring the test was used where arbitrary weights were assigned to the responses. A 5 point weighing system was used, the weight of 5 always being assigned to the response which was most socially acceptable or most favorable and the weight of 1 to the response which was most socially unacceptable.

The criterion of internal consistency was used to validate the items. From the test consisting of 174 items, 98 yielded critical ratios of 2.00 or more. These 98 items were retained for the revised test. The revised test consisted of 26 items referring to the police; 18 referring to the Juvenile Court; 22 referring to probation; 16 referring to detention; and 16 referring to the Boys' Industrial School. The following are examples of the items in the test:

The police have it in for boys.

___Strongly Agree ___Agree ___Undecided ___Disagree ___Strongly Disagree

The Juvenile Court is too hard on boys for little things.

___Strongly Agree ___Agree ___Undecided ___Disagree ___Strongly Disagree

Probation officers seem to know how boys feel when they are in trouble.

___Strongly Agree___Agree___Undecided___Disagree___Strongly Disagree

The detention home is just like the home of a large family.

___Strongly Agree___Agree___Undecided___Disagree___Strongly Disagree

Boys wouldn't mind going to the Boys' Industrial School if other boys didn't know about it.

___Strongly Agree___Agree___Undecided___Disagree___Strongly Disagree

The reliability coefficients were obtained for the 5 scales by both the test-retest method and the split-half method, corrected by the Spearman-Brown formula. All 5 scales were found to be highly reliable. The reliability coefficients ran from .85 for the juvenile court scale to .98 for the detention scale by the test-retest method and from .92 for the probation scale to .98 for the detention scale by the split-half method, corrected by the Spearman-Brown formula. The reliability for the entire test was .91.

THE SAMPLE

The main experimental group consisted of 133 white boys who had been handled officially and placed on probation by the Montgomery County Juvenile Court (Dayton) between June, 1952, and June, 1953, and 133 non-delinquent white boys matched for age, number of years completed in school, intelligence (determined by the California Test of Mental Maturity), occupation of father, and residence.

The nondelinquent boys were cleared through the Social Service Exchange to make sure that they had not been known to the Juvenile Court.

The two groups ranged in age from 13 to 18, with a mean for the delinquents of 15.5 and for the non-delinquents 15.3. In both groups the largest number of cases fell in the 15 year old group.

The majority of the cases of both the delinquents and nondelinquents had completed 9 years in school. Three of the delinquents had completed 7 years in school, one had completed 10, and one had completed 11. None of the nondelinquents had completed as few as 7 years in school and none had completed 11 years in school. The mean number of years completed in school was 8.9 for the nondelinquents and 8.8 for the delinquents.

The California Test of Mental Maturity was used to test the intelligence of the boys in the two groups. The delinquents ranged from 61 to 118 and the nondelinquents from 57 to 119. The mean intelligence quotient for the delinquents was 87.1 and for the nondelinquents it was 84.7.

Recognizing that attitudes may be influenced by the type of home in which a boy is reared, an attempt was made to match the two groups according to the occupation of the father. Since there were about 79 different occupations in which the fathers of the boys were engaged, it was necessary to group them into 5 classifications. Classification I consists of the professional group, including such occupations as doctors, lawyers, and business executives; Classification II, of semi-professional men and managers of large business enterprises; Classification III, of white collar workers, skilled workers, and retail business men; Classification IV, of semi-skilled workers; Classification V, of unskilled workers, such as ditch diggers, garbage collectors, janitors, and ordinary factory workers; Classification VI, of unemployed men; and Classification VI, of men absent through death, divorce, imprisonment, and desertion.

Over 75 per cent of the fathers of the boys are engaged in occupations falling in classifications IV and V. Few of the fathers are engaged in occupations which call for a high degree of morality—such as teachers, doctors, lawyers, and preachers, and only in one case is the father of a delinquent boy unemployed.

The majority of the sample comes from low rent areas near the central business district of the city. The median amount of rent paid per month was respectively $27.72 and $27.59 for the delinquents and nondelinquents.

Many of the delinquent boys have been known to the Juvenile Court at very early ages. The average number of times the 133 delinquents had been to the Juvenile Court in their life histories was 4.21. These boys, then, have had an opportunity to form attitudes toward the legal agencies of authority for juveniles.

FINDINGS AND CONCLUSIONS

It was hypothesized that if a group of boys had had contact with the legal agencies of authority for juveniles and another group of boys had not, there would be a difference in the attitudes of the two groups.

The means and standard deviations for each of the five groups of items in the test and the entire test are presented in Table 1. The critical ratios between the delinquent and nondelinquent groups are also presented in the same table. In only one group of items (Items Referring to the Police) do we find a critical ratio of 2.58 or more indicating a significant difference between the two groups. For the other four groups of items no critical ratio of 2.00 or more was found between the two groups. However, the critical ratio for the entire test was 2.27, indicating a statistically significant difference beyond the .05 level.

Table 1. -- Means, Standard Deviations, and Critical Ratios of the Differences Between the Means

N = 133 in each group

Scale	Nondelinquents		Delinquents		Critical Ratio
	Mean	Standard Deviation	Mean	Standard Deviation	
Police	92.44	16.70	82.90	14.73	4.95
Juvenile Court	58.98	6.31	59.21	7.47	0.27
Probation	70.26	9.30	68.99	11.41	1.00
Detention	54.25	5.56	54.70	8.94	0.49
Boys' Industrial School	52.07	5.12	51.24	7.26	1.07
Composite	325.28	28.18	316.26	36.07	2.27

Scores on a test such as this might be affected by factors other than the official handling of a boy in the Juvenile Court. Therefore, we have studied the relation of

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the composite score to chronological age, intelligence, occupation of father (for an indication of socio-economic status), and body type. The results are presented in Tables 2, 3, 4, and 5.

Table 2. -- Relation of Scores to Chronological Age

Age Group	Nondelinquents			Delinquents		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
Under 15	87	324.57	28.15	72	310.76	34.60
Over 15	46	321.20	27.10	61	323.57	22.90

Both the delinquents and nondelinquents were divided into two groups on the basis of age (those under 15 and those above 15). The mean scores and standard deviations were obtained for each of the four groups for the composite score. The highest critical ratio obtained was 2.51 between the delinquents under 15 and those over 15. This difference between the older and younger delinquent boys was not significant. Age, then apparently has little affect on the scores.

Table 3. -- Relation of Scores to Intelligence

*Intelligence Quotient	Nondelinquents			Delinquents		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
Under 85	66	322.72	27.75	74	314.87	34.00
Over 85	67	327.05	28.50	59	318.01	37.00

*Intelligence quotients were determined by the California Test of Mental Maturity.

The delinquents and nondelinquents were subdivided into groups consisting of those with intelligence quotients above 85 and those below 85. The results agree with those of Sweet,[2] Reusser,[3] and Erwin,[4] since they indicate that intelligence does not affect scores on tests of this nature. None of the differences are significant, the largest critical ratio being .89 between the sub-groups of nondelinquents.

Table 4. -- Relation of Scores to Occupation of Father

Occupational	Nondelinquents			Delinquents		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
V	65	325.58	25.50	60	311.25	38.25
All Others	68	325.74	29.50	73	324.83	32.25

In the absence of other methods of determining socio-economic status, the occupations of the fathers of the boys were used. The two groups were divided into those falling into Classification V and all other classifications. There is a significant difference between the scores of the delinquent boys when socio-economic status is considered. The critical ratio between the two sub-groups was 2.20. There was no significant difference between the two subdivisions of the nondelinquent boys, the critical ratio being .03.

The boys were asked to rate themselves as either "Fat," "Muscular," or "Skinny." The means and standard deviations for the three groups of scores for both the delinquents and nondelinquents are presented in Table 5.

Table 5. -- Relation of Scores to Body Type

Body Type	Nondelinquents			Delinquents		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
Fat	21	326.85	23.15	17	306.68	32.10
Muscular	71	317.43	25.08	75	317.67	31.00
Skinny	41	332.01	31.50	41	318.60	45.50

No significant differences were found between any of the groups when body type is considered. The highest critical ratio was 1.59 between the boys who rated themselves as "Fat" and those who rated themselves as "Skinny" in the delinquent group. Thus we conclude that body type, as determined by the self-rating system, does not affect the scores on the test.

Five items were placed at the end of the test to see whether or not the boys had knowledge of other boys who had had contact with the legal agencies of authority for juveniles. From the responses we can, to a certain extent, determine the associates of the boys. The results for the five items referring to knowledge are presented in Tables 6, 7, 8, 9, and 10.

Table 6. -- Knowledge of Boys Who Have Been Picked Up by the Police

Response	Nondelinquents		Delinquents		Per Cent Difference
	Number	Per Cent	Number	Per Cent	
Yes	100	75.2	128	96.2	21.0
Undecided	8	6.0	4	3.0	3.0
No	25	18.0	1	0.8	18.0
Total	133	100.0	133	100.0	
	Chi Square = 24.08				

Table 7. -- Knowledge of Boys Who Have Been to the Juvenile Court

Response	Nondelinquents		Delinquents		Per Cent Difference
	Number	Per Cent	Number	Per Cent	
Yes	86	64.7	114	85.7	21.0
Undecided	15	11.3	5	3.8	7.5
No	32	24.0	14	10.5	13.5
Total	133	100.0	133	100.0	
	Chi Square = 15.96				

Table 8. -- Knowledge of Boys Who Have Been on Probation

Response	Nondelinquents		Delinquents		Per Cent Difference
	Number	Per Cent	Number	Per Cent	
Yes	61	45.9	103	77.4	31.5
Undecided	27	20.3	8	6.0	14.3
No	45	33.8	22	16.6	17.2
Total	133	100.0	133	100.0	
	Chi Square = 28.96				

Table 9. -- Knowledge of Boys Who Have Been to the Detention Home

Response	Nondelinquents		Delinquents		Per Cent Difference
	Number	Per Cent	Number	Per Cent	
Yes	76	57.1	93	69.9	12.8
Undecided	21	15.8	10	7.5	8.3
No	36	27.1	30	22.6	4.5
Total	133	100.0	133	100.0	
	Chi Square = 6.16				

Table 10. -- Knowledge of Boys Who Have Been to the Boys' Industrial School

Response	Nondelinquents		Delinquents		Per Cent Difference
	Number	Per Cent	Number	Per Cent	
Yes	49	36.8	93	69.9	33.1
Undecided	26	19.6	11	8.3	11.3
No	58	46.6	29	21.8	21.7
Total	133	100.0	133	100.0	
	Chi Square = 29.38				

The results clearly indicate that the delinquents had more acquaintances with boys who had been picked up by the police, had been to the Juvenile Court, knew more boys who had been on probation, and had been to the Detention Home and to the Boys' Industrial School. There is a tendency for "birds of a feather to flock together."

It was highly desirable to administer the test to boys from Dayton currently in the Boys' Industrial School, Lancaster, Ohio. The assumption here was that boys whose behavior was serious enough to result in a commitment to a state training school would be more hostile toward the legal agencies of authority than the nondelinquent boys or the delinquent boys whose behavior lead to probation. Unfortunately, the number of boys from Dayton at the Boys' Industrial School was not large enough to make significant comparisons. Nevertheless, returns were obtained from 44 white boys and 37 Negro boys and it was felt that these results should be presented in the dissertation.

There is a significant difference between the scores of the nondelinquents and the delinquents who have been to the Boys' Industrial School on all groups of items.

Table 11. -- Means, Standard Deviations, and Critical Ratios of the Differences Between the Means

	N
Nondelinquents	133
Boys' Industrial School	81

Scale	Nondelinquents		B.I.S. Delinquents		Critical Ratio
	Mean	Standard Deviation	Mean	Standard Deviation	
Police	92.44	16.70	69.32	16.20	10.01
Juvenile Court	58.98	6.31	50.80	8.60	7.43
Probation	70.26	9.30	60.43	11.70	6.34
Detention	54.25	5.56	41.17	9.20	11.57
Boys' Industrial School	52.25	5.12	46.23	8.20	5.56
Composite	325.28	28.17	274.54	38.75	10.25

There is considerable evidence to support the hypothesis that delinquent boys are more hostile toward the legal agencies of authority for juveniles than nondelinquent boys. The fact that the Dayton Police Department does not have a Juvenile Aid Bureau which could make short contacts with pre-delinquent boys might be a factor operating to produce the hostility of the boys who have had contact with the police.

The comparisons presented here do not tell us whether the more serious cases have the greater hostility because they are serious or whether they pick it up while associating with more sophisticated boys. Further research would have to be conducted to explore this problem. Our assumption here is that both factors contributed to it.

Microfilm $2.50; Xerox $5.60. 111 pages.

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Abstract published by special arrangement with The Ohio State University.

THE EFFECTS OF SIX CONDITIONS ON CONSENSUS ACHIEVEMENT

(L. C. Card No. Mic 59-5463)

Donald Pearce Hayes, Ph.D.
University of Washington, 1959

Chairman: Frank Miyamoto

The assumption of consensus regarding basis goals, values, and means to ends has been common among theorists in sociology from Comte to the present. The absence of consensus has been suggested to lead to undesirable consequences.

It is the purpose of this dissertation to assess the differential consequences of the presence or absence of consensus and to evaluate the effects of five conditions under which consensus is achieved. An experimental design consisting of three phases was used with college students as subjects. The first phase introduced a hypothetical problem to which each subject developed a solution. The second phase consisted of a discussion between pairs of subjects in which they were required to resolve their differences of opinion. Pairing in most experiments was random. Each subject's private opinion was re-assessed in the third phase.

The five dependent variables were: satisfaction with the agreed-upon solution, the "atmosphere" during the discussion, the degree of heightened conviction in the final opinion, the time required for each pair to agree, and the stability of the agreement reached during the discussion.

The six conditions under which consensus was sought were: the degree of initial consensus, the initial degree of intimacy between the group members, the degree of initial conviction in each individual's attitude toward the hypothetical problem, the degree of status differentiation between the group members, the degree to which genuine agreement is sought, and the degree of foreknowledge of other's attitude toward an issue.

The principal observations were designed to evaluate the consequences of being matched with a person with whom the subject agreed as against being matched with one who disagreed. The results are hardly surprising, but the intent was to evaluate the extent of the differences, not to establish the differences themselves. Initial agreement consistently and substantially required less time to reach accord, produced greater satisfaction, produced more stable decisions, and produced a more pleasant consensus attempt than initial disagreement. No differences between those who initially agreed and those who initially disagreed were found in the extent to which conviction was raised by their efforts to reach consensus.

The analysis of the five independent conditions shows the following conditions are among the determinants of the success of consensus attempts: the degree of intimacy between the participants, the degree of status differentiation, the type of consensus sought, and the extent of foreknowledge of disagreement. The evidence which supports the last three conditions is weaker than the evidence in support of the degree of intimacy condition. Persons of different levels of conviction in their solution to the hypothetical problem were not distinguishable from one another in their responses to the dependent variables.

The data provided an opportunity to observe the effects of compromise and conversion as means of resolving disagreements. Conversion was more commonly used and resulted in more stable decisions than compromise. In general, those joint decisions which remained unchanged were reached more rapidly, resulted in greater strengthening of conviction, and provided greater satisfaction than those joint decisions which were abandoned later in the experiment. Those who "converted" their partners to their own point of view experienced more of a strengthening of conviction and were much more satisfied with the decision reached than those who were the "converts."

The intimacy condition provides strong support for Theodore Newcomb's ABX model of communicative acts. There is also a striking contrast between the consequences observed among "natural" groups of mutual friends and "ad hoc" pairs of strangers, which suggests the extent of the limitations to extrapolating results from "ad hoc" groups to "natural" groups.

Microfilm $2.50; Xerox $7.60. 161 pages.

NATIONALITY GROUPS AND SOCIAL STRATIFICATION: A STUDY OF THE SOCIOECONOMIC STATUS AND MOBILITY OF SELECTED EUROPEAN NATIONALITY GROUPS IN AMERICA.

(L. C. Card No. Mic 59-5570)

Charles Benjamin Nam, Ph.D.
The University of North Carolina, 1959

Supervisor: Rupert B. Vance

The present research was undertaken in order to answer the following questions: (1) What variations in socioeconomic status exist among specific nationality groups in America? (2) Are nationality groups with a dominant language and culture like that of the natives most closely assimilated to native status patterns? (3) Has the second generation of each nationality group bettered the position of the foreign-born generation? (4) To what extent are differences in educational level related to the socioeconomic status and mobility of the groups? (5) Are status patterns for nationality groups similar for different areas of the country?

The study was limited to men among ten nationality groups of European stock, five from "old" immigration and five from "new" immigration countries. Using 1950 Census data, status indices were derived from a socioeconomic scale of occupations and educational indices from data on years of school completed. All data were standardized to remove the differential effects of age and urban, rural nonfarm, rural farm residence.

The major findings were: (1) "Old" immigration stock ranked generally higher on the status ladder than "new" immigration stock, but the difference was not substantial. Furthermore, some of the "new" nationalities ranked above some of the "old." (2) Groups most like the natives in language and religion had status indices closest to that of the natives. However, not all groups which were high status or most upwardly mobile shared the predominant language and religion of the natives. (3) The status level of the second generation (all groups combined) was much higher than that of the foreign-born generation. However

generational mobility was lacking for the English and Welsh and negligible for the Germans. The Russians topped the scale in both generations, although mobility was greater for the Irish and the Scandinavians. Three of the foreign-born and six of the second generation groups ranked higher than the natives. Despite this general mobility, the positions of the several groups were as widely dispersed in the second generation as in the first. (4) A high positive correlation was found between education and socioeconomic position. The correlation was significant for both generations, but higher for the second than the first generation. A significant correlation was also found between generational changes in education and status. Most important was the fact that all groups which had raised their statuses between generations had also raised their education levels, and both groups which had not been mobile had lowered their educational levels. (5) Status ranks of the groups were similar from area to area but status levels differed sharply, being highest in the South and higher in the western than eastern regions. Area variations in the status levels of the general population accounted, in part, for the area variations in the levels of nationality groups.

Nationality groups have shared significantly in the status mobility afforded by the open-class system in the United States. Educational attainment seems to be one of the predominant explanations for this mobility. As these groups increasingly become assimilated, association of their members with ethnic origins diminishes. This suggests that, more and more, the status positions of these persons are dependent on their individual and personal qualifications, rather than on the prestige of their ethnic groups of origin.

Microfilm $3.00; Xerox $10.40. 232 pages.

INTERNAL MIGRATION IN INDIANA

(L. C. Card No. Mic 59-6500)

Eleanor Noble Nishiura, Ph.D.
Purdue University, 1959

Major Professor: James M. Beshers

Traditionally studies of internal migration have dealt with one of two aspects of the result of migration: the characteristic of those areas which people have moved from or those areas which they move to or the characteristics of those who do not. In contrast, this thesis centers upon the act of deciding to migrate—the incidence of migration. Instead of simply listing the characteristics of migrants or the characteristics of areas of origin or destination, it has attempted to draw together with one theoretical framework these traditional kinds of findings. The scheme used for this purpose is the theory of internal migration developed by Sara Smith and based upon the "Theory of Action" of Parsons, Shils, and others.

Since demography has generally emphasized empirical findings rather than the testing of theory and since recent literature has suggested that model building cannot proceed until more adequate data are available, additional emphasis has been upon assessing the usefulness of census data for testing a theory such as this.

The first step in the analysis of data used Miss Smith's formulation to bring order to the rather unrelated findings of Bogue and Hagood's study of migration differentials in the Corn Belt. Since the theory was found to be consistent with these findings, hypotheses which followed from her three major hypotheses and which were appropriate for an analysis using census data were formulated and tested with both 1935-40 and 1949-50 information about migration.

Analysis was limited to those whom Miss Smith calls location-migrants, those who move or remain because their role-structuring controls the location of residence. (These persons are contrasted to those who move or remain because of their relationship to others). These location-migrants are heads of families, single working people, husbands, etc., and the crucial variable for determining which of these persons have a high, rather than a low, predisposition to migrate is occupation.

Because of the interrelationship of theory and data, hypotheses were formulated in terms that could be tested with the data that were available. Upon the assumption that male migrants could be regarded as location-migrants the hypotheses were stated in terms of the occupational categories of these males even though these categories are not very specific. Greater confidence in the hypotheses was gained by considering the relationship between several of the demographic characteristics and the main variable of occupation. For example, if it is recognized that certain kinds of occupations require a great deal of education, hypotheses could be tested about the highly educated in contrast to those persons with only a little education. Finally, general information about the occupational structure of rural, suburban, and urban areas aided in the testing of hypotheses.

Before assurance in any theory is gained, it must be tested again and again but this is not to suggest a useless repetition of the same procedures. Instead, the theory must be tested at different times, different places, using more refined methods and data, and making modifications when they seem to be necessary.

Our analysis showed that the three sets of data which refer to two different periods of time showed consistency among each other and did not contradict the theory which was being tested. These findings showed that census data can be extremely useful at one stage in the testing of a theory and in this particular instance, with a minimum of costs they convince us that Sara Smith's theoretical framework "makes sense" in terms of empirical data.

Microfilm $3.80; Xerox $12.80. 293 pages.

INTERPERSONAL FACTORS IN THE DISPOSITION OF JUVENILE OFFENDERS: POLICE AND JANITORS AS APPREHENDERS.

(L. C. Card No. Mic 59-6315)

William Rudolph Rosengren, D.S.S.
Syracuse University, 1959

Supervisor: Nathan Goldman

The purpose of this study was to investigate the ways and extent to which two different sets of functionaries differed in their handling of juvenile offenders. Past studies

have attempted to distinguish adjudicated delinquents from non-adjudicated delinquents on the basis of either characteristics of offenders or characteristics of apprehender phenomena as selective differentia. Such studies have resulted in either conflicting or inconsistent findings. It was thought that a transactional approach which viewed apprehension and arrest as an interpersonal process might suggest a possible clarification. The major assumption of the study was that the selective factors in the differential disposition of juvenile offenders could be found to be functions of relationships between offender attributes and apprehender phenomena within the context of limited interpersonal situations.

Three hypotheses were proposed:

I. Some types of offender behaviors will elicit punitive responses from apprehenders regardless of differences in the occupational role of apprehenders.

II. Other types of offender behaviors will elicit selective responses from different role-categories of apprehenders.

III. Differences in the disposition of offenders are related to differences in social characteristics between offenders.

An array of sixteen behavioral characteristics are derived from Henry Murray's 'need-press' scheme. A generalized apprehension situation was designed for each behavioral quality. A sample of ten park policemen and ten public school janitors were interviewed with regard to their experiences with cases of property destruction by juveniles. They were then presented with each of the sixteen hypothetical apprehension situations and asked to indicate how they typically handled such offenders. Chi-squared and Fisher's exact test of probability were used as tests of significance.

All functionaries reacted punitively toward the Aggressive offender type. The encumbents of both role-categories tended to react non-punitively toward the Communicable, Blamavoiding, Conjunctive, and Succorant offender types. Only the police tended to react punitively toward the Rejecting, Self-abasing, and Placid offender types. The janitors tended to react non-punitively toward those types. Conversely, only the janitors tended to react punitively toward the Autonomous, Narcissistic, Impulsive, and Emotional offender types; the police tended to react non-punitively toward those types. There were no differences between the two role-categories of respondents in terms of total punitive responses. The first and second hypotheses were accepted. Thirteen dichotomous apprehender variables were used as tests of validity for the second hypothesis and as independent variables for the third hypothesis. The results indicated that the patterns found for the second hypothesis could be regarded as probably valid. The third hypothesis was rejected.

A consideration of the comments of the respondents during the interview sessions indicated that for individual cases the following general tendencies existed: (1) the orientation that an apprehender took toward juvenile offenders was related to his conception of his own role, and (2) the orientation that an apprehender took toward juvenile offenders was related to the kinds and extent of integration he had with his work milieu.

Within the limits of the methodology employed, the following tentative conclusions were drawn: (1) different types of offender behaviors tend to elicit different responses from apprehenders, (2) other types of offender behaviors tend to elicit differential responses from different role categories of apprehenders, and (3) selective factors in the disposition of juvenile offenders appear to be a function of transactions which take place between offenders and apprehenders as an interpersonal process.

Microfilm $2.50; Xerox $8.00. 174 pages.

THE INTERNALIZATION OF VALUES BY WORK GROUPS AND THE POPULARITY OF NOMINATED LEADERS

(L. C. Card No. Mic 59-3144)

Herman Turk, Ph.D.
The American University, 1959

Recent research studies, particularly those reported by Bales and his associates, have restimulated interest in the relationship between instrumental leadership and expressive status. Contradictory findings appear in the literature. Some investigators have demonstrated considerable correspondence between occupancy of leader roles and personal popularity; other studies revealed low or negative association between the two structural attributes. These disparate results suggest the need for further specifications of the conditions under which popularity and leadership coincide and the conditions under which they do not.

Each of the groups studied in the past may be viewed as having existed within some broader institutional context, which defined its instrumental activities. Such activities are assumed to have had different meanings in groups displaying low correspondence between attributed leadership and popularity than in those displaying high correspondence. It is likely that the former type of structure existed where institutional expectations were unimportant to the group's membership or where they appeared in the form of external constraints. The latter type probably obtained where institutional expectations were internalized as central values by the membership.

The works of Parsons, Homans, and Newcomb have suggested that being well-liked may be defined as a relational reward accorded to actors who best realize cherished values. Instrumental leaders are defined as those members seen as contributing most to the group's realization of instrumental expectations. Where these expectations constitute central values to the membership, we might expect that leaders would be popular. Where the institutionally defined activities are of low or negative valence to members, members' evaluation of leadership will be irrelevant or opposed to other kinds of evaluations they make of one another, such as those of personal attractiveness. Consequently the following hypothesis is offered:

The more widespread the internalization of the task activities of a group as positive central values by its members, the more likely is it that those persons nominated as institutional task leaders will also tend to be particularly popular as personal intimates.

The following operations constitute an investigation of the hypothesis.

Five groups of 10 - 26 student nurses were tested before and after each began its 12 - 16 week period of

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

training and service in psychiatric nursing. The before data for one group suffered from misinterpreted instructions and were not used.

Degree of similarity between each student's description of "good psychiatric nurse" and "ideal self" on the Leary Interpersonal Check List was scored. The distribution of these scores for a given group measured its rate of internalization of task values. Four groups could be ranked according to the distribution of instructors' final ratings of member motivation toward psychiatric nursing. Motivation rate and final internalization rate placed the four groups in identical rank orders ($p < .05$), thereby suggesting validity for the latter index.

Student nurses receiving sociometric choices as psychiatric head nurse from more than a third of their peers were called leaders. Validity is suggested, since final leaders received above average final grades for their laboratory work in psychiatric nursing more often than did non-leaders ($p < .05$).

A person receiving more than the median number of choices as room-mate was considered popular.

The after data of the two groups revealed conspicuously high rates of internalization. All leaders were popular and significantly more so than non-leaders only in the after testing of these two groups ($p < .01$ and $p < .05$). This ordering of groups is significant at $p = .10$ if only after data are considered and at a higher level if the nine before or after testings are considered.

After having eliminated various sources of potential spurious interpretation, the hypothesis is considered supported. This conclusion has implications for studies of socialization, routinized charisma, and bureaucracy.

Microfilm $2.50; Xerox $4.40. 81 pages.

AN ANALYSIS OF SOCIAL CHANGE IN A SWEDISH-IMMIGRANT COMMUNITY: THE CASE OF LINDSBORG, KANSAS.

(L. C. Card No. Mic 59-5657)

Wayne Leland Wheeler, Ph.D.
University of Missouri, 1959

Supervisor: Dr. C. T. Pihlblad

This dissertation is a study of the continuity in the development of the Swedish-immigrant community of Lindsborg, Kansas. The theoretical orientation is largely that derived from the concepts of communal and associational societies as they can be applied to social change. The method is that of the community study plus the application of an ex post facto perspective to ideal types, social structure, and latent and manifest functions. The data were gathered by such techniques and from such sources as official documents and reports, community histories, and interviews.

The Old-World milieu of the Lindsborg settlers is surveyed. Factors of religion, poverty, class, and the use of intoxicants are found to be important causes of emigration. These have a major bearing upon the Lindsborg sociocultural system.

A general view of the New-World community—its location, boundaries, and topography, is presented. The historic origins of the institutions and values of the village are discussed. The diversity and differences, both latent and manifest, within a framework of communalism and equality are suggested. The early leaders in the settlement are shown to have influenced the divisions in the community, and to have also created unity by developing themes around which the citizens could rally. The local manifestations of education, religion, the family, and government are described.

The organization of the typical Lindsborg family is discussed as are changes in the village's population. Out migration is related to desires for social equality and to the frontierism upon which the community is based. Further, the present-day youth culture is associated with social change and the preparation of young people for leaving the community. Both the youth culture and the out-migration are associated with education.

As a consequence of the success of education in preparing the youth of the village for life in the outside world, and as a consequence of the influence of the greater society on the public schools, Bethany College, Lindsborg's institution of higher education, has attempted to broaden its base of support by broadening its community.

Religious developments are traced and are found to have been characteristic of other aspects of the community's history. The cleavages in religion continue to influence the nature of the social system, and serve to indicate the transition from communal-type to associational-type social organization.

The use of myths concerning the pioneer settlers and the leaders are shown to be vital in preserving a certain unity in the community. This is also true of Holy Week and Hyllningsfest rituals.

Throughout the investigation, Lindsborg's relations with the extra-community world and the larger society are suggested in greater or lesser degree. The report concludes with a discussion of the relations between the commercial interests and the outside world. These interests are both outward-looking and conservative. Finally, governmental and corporate influences are discussed and shown to be important in the community's change. The future of Lindsborg is closely bound up with developments in the larger society.

Microfilm $4.95; Xerox $16.60. 387 pages.

SOCIOLOGY, FAMILY

A NORMATIVE THEORY OF FAMILY LIFE FOR THE PHILIPPINES

(L. C. Card No. Mic 59-5278)

Jacob S. Quiambao, Th.D.
Boston University School of Theology, 1959

Major Professor: Dr. Walter G. Muelder

Statement of the Problem. The Filipino family has been caught in a conflict and confusion of divergent cultural influences. Lately, the situation has become serious. A philosophy of family life that will guide the Filipino

family through this situation is necessary. The writer believes that the best solution is a normative theory of family life that will weave the fibers of Christian ethics into the fabric of Philippine family life.

Procedure. Throughout the inquiry the following questions are asked: What is the situation? What ought to be done about it? Chapter II lays down the basic ethical principles upon which the proposed theory is based. Chapter III analyzes the conflict of cultures in the Filipino family. Chapter IV describes the nature and process of change, since the proposal of a theory implies change. Chapter V proposes a theory based on Christian ethics. Chapter VI indicates the importance of the study and suggests ways of implementing the proposed theory. The concluding chapter briefly summarizes the issues in the preceding chapters and finally sounds a challenge.

Summary of the Philippine Situation. Three major cultural influences—Oriental, Spanish, and American—are directly involved in the present conflict. Each of these is vying to dominate Philippine family life.

The Oriental influence in Philippine culture is basically Malayan and Chinese and has given rise to a Filipino family system that is both progressive and conservative.

The Spanish influence upon Philippine family life, mainly through the Roman Catholic Church, is largely conservative and authoritarian. It has reinforced such original Filipino family patterns and traits as respect for and obedience to elders, especially parents, care for aged relatives, and strong family ties.

The American influence has so far been the most revolutionizing. Its principles of democracy have considerably influenced the Filipino way of life. Hollywood movies and cheap literature have often been singled out as partly responsible for the disintegration of some valuable traits of the Filipino family.

Confusion in the Filipino family today is rooted largely in conflicting patterns of authoritarianism and democracy, of inequality and equality of the sexes, of romantic love and conservative type of courtship, and of familism and individualism. The conflict is basically between the old and the new and is psychological and cultural in nature. Hence, the individual may be said to be living in a world characterized by a veneration of the past and at the same time an appropiation of many things that are Western.

The Core Theory. An abundant family life is one that provides the conditions for the physical, emotional, mental, and spiritual growth and development of each member into a mature Christian personality. The family exists for the individual more than the individual for the group but at the same time the individual cannot flourish apart from corporate living. Much of the success and happiness of the individual depends upon the quality of his relatedness to the group. Moreover, the family as conceived in this proposed theory is one that helps preserve and stabilize the valuable traits and qualities already achieved, a function which not even society can provide.

Conclusion. It is important that the theory is suitable to the physical and cultural setting and that it utilizes the tools of the given society. Under the circumstances the most preferred solution to the problem seems to be an eclectic approach to the Oriental, Spanish, and American influences, that is tested and supplemented by the principles of Christian ethics. It is assumed that the theory derived from such a method can give effective guidance to the Filipinos in achieving the ultimate goal of abundant life that is truly under God.

Microfilm $2.90; Xerox $10.00. 221 pages.

SOCIOLOGY, PUBLIC WELFARE

A STUDY OF SELECTED ASPECTS OF THE SOCIAL WORK RESEARCH PRACTICUM

(L. C. Card No. Mic 59-5267)

Adriana Ramu de Guzmán, D.S.W.
Washington University, 1959

Chairman: Dr. Harris Goldstein

This study sought school of social work faculty member's opinions whether there should be a research practicum, what should be its objectives and the methods that should be used to achieve them, to assist social work educators in planning and evaluating this part of the social work curriculum. This seemed important because the writer considered the research practicum to carry a heavy responsibility for incorporating a scientific attitude into social work.

Conclusions were based on 78 per cent of responses to a mailed questionnaire sent to 34 per cent (144 respondents, forty-five from research faculty and ninety-nine from faculty other than research) of the known full time faculty teaching in November, 1958 in schools of social work.

Total faculty's opinions as well as similarities and differences within and between the research faculty and the other faculty were studied.

No significant difference occurred in the median number of years of teaching experience of research and other faculty, but there was a significant difference in the level of professional education attained by each group. The doctorate was held by 67 per cent of the research faculty but by only 14 per cent of other faculty.

Though some agreement was on methods and some on objectives, all disagreement was on methods of teaching the research practicum.

Both research and other faculty agreed in selecting most frequently the following five educational objectives as desirable for the research practicum: (1) to give student an orientation to the research approach and beginning facility in applying some of the fundamental principles and techniques; (2) to develop in the student a critical approach toward theory and practice as a means to contributing to the knowledge and improvement of social work practice; (3) to develop in the student ability to organize and present material clearly in a manner appropriate to the data; (4) to develop in the student a spirit of discovery about things as they are; (5) to provide experience in the application of research methods to current social welfare materials.

Agreement was found within research faculty, within other faculty or between the two faculties or both on preference for;[1] (1) no discontinuance of the research practicum; (2) original observations made by students over observations made by others as research practicum data; (3) students' selection of topic for research over selection by others; (4) flexibility in the methodological or teaching device over use of a fixed method; (5) emphasis on a good learning experience during the research practicum over emphasis on quality, importance and usefulness of findings; (6) the responsibility for supervision by research trained persons over persons with most knowledge of the subject studied.

The two groups disagreed, within and between themselves; (1) in their preference of a subject for the research practicum; (2) whether to encourage students to

pick a topic among those topics faculty are or might be studying or a topic of their own regardless whether faculty are working on problems in the same area; (3) whether all faculty or only specially designated faculty should participate in supervision of the research practicum.

More areas of similarities than of differences were found within and between the two groups of faculty. This suggests enough common ground for collaboration in providing better scientific knowledge for the social work practitioner. Microfilm $2.50; Xerox $5.00. 100 pages.

1. Agreement within faculties required a dichotomy more extreme than 74%-26%. Agreement between faculties meant lack of significant difference at the 5 per cent level between the two proportions.

SOCIOLOGY, RACE QUESTION

THE OPINION OF NEGRO CHILDREN TOWARD WHITES

(L. C. Card No. Mic 59-5500)

Charles Henry Thomas, Jr., Ed.D.
The University of Oklahoma, 1959

Major Professor: Claude Kelley

The purpose of this study was to identify the opinions of Negro children toward whites. It was assumed that the implications of these opinions would be more meaningful if the investigation answered specifically the following questions:

1. Do the opinions of females differ significantly from those of males?
2. Do the opinions of respondents differ on the basis of difference in age?
3. Do the opinions of respondents at one grade-level differ from those of another?
4. What are the opinions of Negro public school students toward whites?

The design of the study sought to establish the expressed opinions of 342 Negro students. The answers of 159 males and 183 females were analyzed. The Chi-Square statistical test of significance of difference was used to determine the significance of difference of the opinions. The principal findings of this investigation are based on the analysis of the expressed opinions of Negro children toward white people.

While tests of significance of difference failed to yield a significant return between opinions by sex, by age, or by grade-level, some trends were noted. The number of traits on which the two races were thought to be similar by 45 per cent or more of the respondents increased steadily in number as grade-level and age of the respondents increased. Traits on which the respondents most nearly agreed and that were held by a majority of the total group were:

1. Whites are more mercenary and deceitful than Negroes.
2. Negroes are more powerful physically, musical, religious, and rapid than whites.
3. The two races are similar in intelligence, materialism, and laziness.

Conclusions:

The opinions of Negroes toward whites are not peculiar to sex, ages 10 through 20, nor grades V through XII. But this does not mean to say that educational and social problems incident to opinions of Negroes toward white people should be dealt with without due consideration to differences by sex, age, and grade level.

Recommendations:

It is recommended that further study be made using the same instrument used in this study, or a modified version of it, with white students as respondents. It is recommended that further study include grade III and continue through college. This might help determine at what age and grade stereotypes first enter the minds of individuals and at what age and grade they lose much of their authority.

Microfilm $2.50; Xerox $5.40. 108 pages.

SPEECH - THEATER

A STUDY OF THE COMPARATIVE EFFECTIVENESS OF TWO METHODS OF PRESENTING TO PARENTS INFORMATION RELATIVE TO SPEECH AND LANGUAGE DEVELOPMENT IN THE PRESCHOOL CHILD

(L. C. Card No. Mic 59-6088)

Rosabell Ray Battin, Ph.D.
The University of Florida, 1959

This study attempts to determine which of two methods, a television presentation or a regular classroom lecture, is the more effective means of presenting information to parents relative to speech and language development in the preschool child. This comparison was made on the basis of presentation, audience acceptance, and audience gain. The latter was evaluated in terms of change in basic attitudes and beliefs regarding the lecture subject following receipt of the information.

Sixty-two mothers of preschool children participated in the experiment. Twenty-seven attended the classroom lecture while thirty-five viewed the television lecture. The instructor was the same for both lectures. The two groups were matched for age, education, socio-economic level, and number of children in the family. Each mother had at least one preschool child.

Both groups of mothers were given the same test instrument before and after hearing the lecture. A second test which evaluated the type of presentation as well as compared this means of presentation with other methods or media was administered to the mothers following the lecture.

The results from the tests were tabulated and a statistical analysis was made of the data.

The results of the study tend to support the hypothesis that facts on speech and language growth intended for mothers of preschool children are better received when presented in a regular classroom lecture than when this material is presented in lecture form over television. However, both television and classroom presentation provide a highly significant change in attitudes and beliefs toward this subject. There appears to be no difference between the two methods of presentation in terms of the amount of internalization or acceptance of the material. Therefore, the difference obtained in favor of the lecture group does not rule out the use of television for adult education in the area of speech and language development.

Microfilm $2.50; Xerox $7.20. 154 pages.

PHONETIC ELEMENTS AND PERCEPTION OF NASALITY

(L. C. Card No. Mic 59-5702)

Lois Anne Brien, Ph.D.
State University of Iowa, 1959

Chairman: Associate Professor Dorothy Sherman

The purpose of the present investigation was to study the influence of some selected vowels and consonant environments on perceived nasal voice quality for both nasal and nonnasal speakers. The vowels were [i], [ɛ], [æ], [ʌ], [ɑ], [ʊ], and [u]. The consonants were voiced plosives [d] and [g], voiceless plosives [t] and [k], voiced fricatives [v] and [z], and voiceless fricatives [f] and [s]. The consonants were used in CVC syllables with the same consonant preceding and following each vowel, a total of 56 such syllables. Each of the seven vowels in isolation also was included, making the total number of syllables 63.

Twenty speakers, 10 with nasal voices and 10 with voices free of unpleasant nasality, recorded the syllables in a sound-treated room using high fidelity recording equipment. The voices were chosen by unanimous agreement among three observers experienced in diagnosis of voice quality disorders. The syllables were rated for severity of nasality on a seven-point equal-appearing intervals scale by 35 listeners. Median scale values were derived from their judgments.

On the basis of the obtained results the following conclusions seem warranted: (1) on the experimental material employed listeners judge nasal voices as more severely nasal than nonnasal voices; the obtained order of severity of nasality on isolated vowels, from vowel to vowel, and on CVC syllables, from syllable to syllable, is essentially the same for both groups. (2) Nasal and nonnasal voices are, in general, most similar in terms of severity of nasality on isolated vowels and most widely separated on CVC syllables. (3) Vowels in isolation are generally perceived as more severely nasal than CVC syllables for nonnasal speakers. (4) Severity of nasality of vowels for all environments combined varies with height of tongue position with higher vowels less nasal than lower vowels. (5) Severity of nasality of vowels varies with the front-back classification of vowels with back vowels less nasal than front vowels. (6) Syllables with voiceless consonant environments are less nasal than syllables with voiced consonant environments. (7) Syllables with plosive consonant environments are less nasal than syllables with fricative consonant environments. (8) Nasality is least severe for voiceless plosive environments, more severe for voiceless fricative and voiced plosive environments, and most severe for voiced fricative environments.

Microfilm $2.50; Xerox $4.00. 71 pages.

A HISTORICAL STUDY OF PROGRAMMING TECHNIQUES AND PRACTICES OF RADIO STATION KWKH, SHREVEPORT, LOUISIANA: 1922-1950.

(L. C. Card No. Mic 59-5516)

Lillian Jones Hall, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Clinton Bradford

This study surveys the origin and development of programming by Radio Station KWKH, Shreveport, Louisiana, 1922-1950. The analysis includes a survey of plant facilities, staff training and organization, and programming policies and practices through the periods of successive ownerships. The author used chiefly the station files, current government documents, and personal interviews of prominent staff members for her materials. Developed chronologically, the history is presented in the period of origin and experimentation, 1922-1925; the period of W. K. Henderson, 1925-1933; the period of maturity, 1933-1941; the war years, 1941-1945; the post war years, 1945-1950.

William E. Antony, a young engineer employed by the Bell Telephone Company, designed, built, and operated the 10 watt Radio Station WAAG for the Elliott Electric Company in May, 1922. The 100 watt Radio Station WGAQ also designed, built, and operated by Antony replaced the electric company's station. The following year Antony's operation of these early stations was confined to brief nighttime broadcasts of playing phonograph records and reading newspapers. William G. Patterson, owner of WGAQ and dealer in radio receiving sets, enlisted financial aid in the form of partnership of W. K. Henderson, the Shreveport Times, the Youree Hotel, and himself. Studios moved to the Youree Hotel and programming added local talent to recorded music and news. In October, 1924, Henderson bought the hotel and Shreveport Times interests in WGAQ; moved the station to Kennonwood, his plantation eighteen miles north of Shreveport; and changed the call letters to KWKH. The station developed under his direction until 1933. Innovations developed by Henderson included the broadcast of phonograph records directly through a transmitter and direct sales of coffee for support

of the station. In 1930 he increased the power to 10,000 watts, gaining an extensive coverage. International Broadcasting Corporation purchased KWKH in 1932 and moved the station to Shreveport again. A period of re-organization followed, culminating in the affiliation with the Columbia Broadcasting System in 1934. The station programmed heavily from network offerings during the period.

In 1935 the Shreveport Times purchased KWKH and combined the staffs and studios with those of another Times station, KTBS. Four years later KWKH increased its power to 50,000 watts, enabling the station to include more than three million people in its service area. During World War II, the shortage of personnel forced KWKH to train its own staff members. Programming focused on newscasts and government services. The FCC investigated KWKH and its sister station because of their newspaper ownership in 1941. Although no action was taken in this instance, the Shreveport Times sold KTBS in 1944 as a result of the FCC duopoly rule forbidding multiple ownership of stations serving the same area. In 1947, following the employment of Henry Clay as general manager, KWKH put major emphasis on news, farm programming, and folk music. The period covered in this study ended with KWKH attracting the largest listening audience in its history. Microfilm $3.05; Xerox $10.40. 233 pages.

SOME PROBLEMS OF DRAMATIZATION

(L. C. Card No. Mic 59-5382)

John William Hallauer, Ph.D.
The Ohio State University, 1953

No matter what one may think of its artistic validity, there can be no question that in the past the dramatization of non-dramatic forms of fiction and history for the stage has always been a part, and an important part, of playwriting. Today, perhaps even more than in the past, dramatization is a staple of our theatre, especially when one considers not only the stage but also television and motion pictures. However, in spite of the long history of dramatization and its prevalence at the present time, there have been relatively few studies made specifically of this particular branch of playwriting. And these few studies have been made from the outside only, so to speak; that is, they have been comparisons of novels, novellas, short stories, or sketches with the completed dramatizations made from them. Here, then, seemed to be an excellent field of study and a new approach to the subject.

This new approach, which is discussed in Chapter I of the dissertation, was to work from the inside rather than from the outside; that is, to investigate the problems of dramatization as the dramatizer himself would face them. To do this meant to become a dramatizer, and that is what was done. A novel Emma by Jane Austen was dramatized. The dramatization became the basis of the organization, of the chronological sequence, and of the selection of background materials. Since such an approach demands intensive rather than extensive investigation, certain limitations were set at the beginning. They were as follows:

1. The problems of dramatization considered are only those of adapting the novel to the stage, not those of adapting the novella, the short story, or a series of sketches.
2. The problems considered are only those in relation to plays which attempt, to a reasonable degree, to translate the total meaning (theme) and quality (tone and atmosphere) of a novel to the stage.
3. It was assumed that there are degrees in the adaptability of novels to play form. The problems considered are not those related primarily to the novel obviously difficult to dramatize nor to the novel written almost in play form, but to the novel in the middle-range of the scale of adaptability.
4. The almost limitless amount of material which, peripherally at least, could be considered a legitimate part of the investigation was strictly limited by the dramatization of Emma itself. A small number of novels and their dramatizations were studied intensively. Works upon the techniques of the drama and of the novel were studied only in relation to specific problems faced in the dramatization, and only insofar as necessary to solve the problems. Reading of works on Jane Austen's life and novels, and on the social history of her period, was limited to the minimum required to dramatize her novel Emma adequately.

With the above approach and within the above limitations, the specific purpose of the investigation was to discover some, not all, of the important problems met by the dramatizer of a novel, and to suggest a, not the, method of meeting these problems.

In general, the procedure followed was a simple chronological one. The dramatization of the novel Emma was begun. The first major problem was discovered. The problem became a subject for study. When a solution was found to be satisfactory enough for the dramatization to be continued, it was continued, both problem and solution becoming part of the conclusions of the investigation. Another major problem was met and studied. And so on through to the completion of the dramatization.

The first major problem the dramatizer must face, that of selecting a novel to dramatize, actually lay outside the bounds set for the investigation, but nevertheless some helpful suggestions about selection made their appearance during the study--suggestions which are noted in Chapter IV. It would seem obvious that the novel which is dramatic and economical in its plot structure would be easier to adapt than the panoramic and sprawling novel. However, this obvious conclusion must be qualified by consideration of the point of view and objectivity of the novel; that is, by consideration of whether the novel is written in the first or third person and of whether the author is an observer, is involved in the action, or is omniscient of one character, many characters, or none. It was found that, other things being equal, the short novel, the novel in the third person, and the objective novel in which the author uses limited omniscience will be easiest to dramatize. These elements must be considered as well as dramatic plot structure, and they must all be considered in relation to each other to have significance when making the choice of a novel to translate to the stage.

The investigation proper began with the selection of a novel to be dramatized already having been made. Immediately a major problem faced by the dramatizer made its appearance. It was necessary to understand the relationships and the differences between the novel and the drama before another step could be taken. The investigator analysed a number of plays and novels, and studied works on the techniques of both the novel and the drama. From this background study it was clear that the novel can

do anything the drama (in its written form) can do, but that the drama cannot do many things that the novel can do. It was equally clear that the essential differences between the two forms lie somewhere in the contrast between "written to be read" and "written to be performed," with "to be performed" implying all the exigencies of the theatre. Such a statement, however, is not particularly helpful for concrete guidance in dramatization. Further study led to the conclusion that the novel and the drama differ in two primary ways: point of view and compression. The drama demands one point of view--third person, completely objective, with no omniscience of characters. The drama must accomplish its purpose with much more economy than the novel--with less over-all length, less action, fewer scenes, fewer characters, fewer settings. There are certainly other differences between the two forms, but point of view and compression serve as useful guides to the dramatizer in his task.

The next major problem of the dramatizer was found to be the necessity of grasping all the elements of the novel well enough really to understand and to use them—certainly not an easy thing to do. Here the keys to the differences between the novel and the drama, point of view and compression, proved their value. The dramatizer must make a detailed analysis of the point of view of the novel, dividing the material into narrative and scene portions. He must make a condensation of the plot, including story, characters, action, conflict, time sequence, settings and motivations, since it is in these elements that the changes demanded by compression will primarily be made. Furthermore, the dramatizer, in order to discover what elements of drama and dramatic structure are already present, must analyse the novel as if it were a play.

Chapter II of the investigation discusses at length the above two problems: the relationship between the novel and the drama, and some method of grasping and understanding the elements of the novel. Chapter III is a detailed analysis of the novel Emma, both as novel and as play, showing the application of the solution to the second of these problems.

It was found that the next major problem the dramatizer meets is taking the first difficult step that begins the shift of his basic materials from a novelistic to a dramatic structure. This demands a scenario or, at least, that the dramatizer, whatever his individual working method, go through the processes that are represented by the development of a scenario. As shown in detail in Chapter IV of the investigation, the scenario should concentrate upon plot structure and should be guided, once more, by consideration of point of view and compression. This scenario should indicate all locales and the time sequence. It should clarify and unify lines of action, bringing out some logical order of cause and effect. It should show all motivations. It should note all entrances and exits and character groupings. It should divide the conflict into a pattern of crises which rise gradually to a climax, and this division should fit into some practical number of acts or scenes.

Chapters V and VI of the investigation include the detailed development, through five stages, of a scenario and the first draft of a dramatization of the novel Emma. By means of this specific, experimental dramatization further problems of dramatization, and some possible solutions, were found. These, together with some general conclusions upon the whole process of dramatization, are discussed in Chapter VII.

It was found that the problems met at each step of a dramatization remain more or less similar for every dramatizer, but that the solutions in the later stages of the process grow increasingly specialized, until generalization about them becomes almost meaningless. Every dramatizer, as he develops his scenario and first draft, must meet the following problems: making subjective material objective; inventing new scenes and, possibly, new characters; motivating entrances and exits and necessary action at the new times and places demanded by the compression of the original plot. Possible solutions to these problems, suggested in Chapter VII of the investigation (using a confidant, telescoping scenes, finding motivations in scenes already written in the novel), are applicable only to novels similar in type to Jane Austen's Emma.

Furthermore, it was found that at some point in the development of the scenario or first draft of the dramatization, the problems of the dramatizer become exactly the same as those of any playwright, no matter what the source of his material may be. These problems are unifying the dramatic illusion, until there is no violation of the illusion or of dramatic plausibility; preparing, foreshadowing, motivating all dramatic action; unifying tone and atmosphere; achieving the ultimate in progression, in suspense, in dramatic irony that the material will allow; giving all action some logical order of cause and effect; economizing on exposition, on character details, on duplication of action, on dialogue; strengthening minor crises, entrances, and curtains; developing brief covering and transitional scenes; in general, doing away with impossible demands upon the normal facilities of the physical theatre and upon the actors, directors, and technicians. All of these problems must concern the dramatizer when working on the scenario, on the first draft of the play, or on any subsequent drafts right up to the final one. The solutions to these problems are so dependent upon the particular dramatization and the individual working method that generalization about solutions becomes almost impossible, even when restricted to one type of novel.

Finally, by putting together all the implications of the individual problems and solutions, it was possible to see the core of the dramatizer's whole task. Since he must compress, for he cannot hope to reproduce the quantity of a novel, the dramatizer's task is, first of all, an extremely careful selection of those plot materials which convey the essence of the elements of the novel. The materials selected must allow of such treatment that the half dozen or dozen episodes of the play can hold a sort of distillation of the fifty or sixty episodes of the novel. The second part of the dramatizer's task is handling the selected materials in such a way that they make dramatic effects rather than narrative effects. This handling of the selected materials means a reallocation of the elements of the novel. The details of characterization, of plot, of theme, of tone, for example, may be given new relationships, new sequences, or may be embodied in new incidents. However, they must retain, at least symbollically, their original essential qualities. It may be said that, because of the demands of the dramatic medium, it is only by re-allocation of the elements of the novel that the essential qualities of the novel can be retained.

In summary, then, the essence of the dramatizer's whole task in reproducing the quality of the novel in dramatic form lies in the compression, selection, and re-allocation of the elements of the novel. Such a

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task is an extremely complex creative process, so complex that probably a really complete analysis of the process is finally impossible.

Microfilm $6.30; Xerox $21.80. 494 pages.

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AN X-RAY STUDY OF UNREPAIRED, COMPLETE CLEFT PALATE ORAL-PHARYNGEAL STRUCTURES AND THEIR FUNCTIONING DURING VOWEL PHONATION.

(L. C. Card No. Mic 59-6102)

F. X. Calvin Knobeloch, Ph.D.
The University of Florida, 1959

In June of 1957 and of 1958, a study team of dentists and a speech pathologist visited the island of Puerto Rico to conduct a field study of individuals with unrepaired cleft palates. This team was sponsored by the United States Department of Health, Education, and Welfare. They made X-ray plates and tape recordings of adults with unrepaired cleft palates. X-ray plates and tape recordings of adults with complete, unrepaired cleft palates were made available to the writer for analysis. The purpose of this analysis was to determine the structural and functional effects of the unrepaired oral anomaly in physically mature individuals. Specifically, the investigation sought to answer the following questions: (1) How does a group of physically mature individuals with complete, unrepaired cleft palates compare with a similar group of normally structured individuals of the same national origin? (2) How does a group of physically mature individuals with complete, unrepaired cleft palates compare with other cleft palate individuals who have undergone surgical repair prior to maturation? (3) What effect does the presence of the unrepaired anomaly have on the speech of the adult?

Twenty Puerto Rican adults with complete, unrepaired cleft palates composed the experimental group. Anteroposterior and lateral X-ray plates, at physiologic rest and during phonation of three vowels, were traced and measured for this group. The control group for the present study was composed of twenty normally structured adults, who had the normal speech and hearing of Puerto Ricans. X-ray plates for this group were also traced and measured for comparative purposes with the experimental group. The measurements of the oral and pharyngeal structures, openings, and movement from rest position to phonation positions were analyzed statistically. The tape recordings of speech samples of both groups in the study were rated for effectiveness of articulation and voice quality.

The analysis of the measurements revealed striking similarities between the two groups. The most pronounced differences found were apparently directly connected with the presence of the unrepaired clefts in the experimental group. The individuals with unrepaired cleft palates displayed greater maxilla width and larger velo-pharyngeal openings during phonation, both of which measurements differed with statistical significance. Other statistically significant differences were found on the various measurements made in the study, but with very little consistency. Some of these measurements also seemed to reflect the presence of the unrepaired anomaly in the experimental group.

The analysis of the speech samples of the experimental group revealed varying degrees of articulatory defectiveness. The most striking finding in this respect was the inconsistency of articulation, which indicated that a functional disorder was operative in addition to the organic disorder. The experimental group showed marked quality differences from the control group. These differences were evaluated as deviations from normal oral and nasal resonance, and may be attributed primarily to the unrepaired oral anomaly with its virtual absence of palatal structures.

Whereas individuals with repaired cleft palates have been found to show structural growth retardation, the experimental group of the present study seems to have approximated normal structural growth.

Disagreements have long existed in the fields of speech pathology and oral surgery in regard to the advisability of early surgical repair of cleft palates. There is evidence to support early surgery and evidence to support postponement of surgery until maximum structural growth has been achieved. Many adherents of the latter position are inclined toward consideration of prosthetic treatment of the cleft structures. The present study would seem to offer strong support to the postponement of early surgical palatal repair, and the consideration of prostheses instead. Such a course of action, it is felt, would allow more normal growth to be achieved and would, in all probability, be advantageous in the development of better speech in individuals with cleft palates.

Microfilm $2.50; Xerox $4.00. 74 pages.

A CASE STUDY OF HUMAN COMMUNICATIONS IN AN URBAN BANK

(L. C. Card No. Mic 59-6490)

Dale Arthur Level, Junior, Ph.D.
Purdue University, 1959

Major Professor: Dr. W. Charles Redding

I. Purpose

The purpose of this study was to investigate human communications—primarily oral—in the First National Bank of [Midcity]: basic communication attitudes of management, communication channels and organization structure, the grapevine, techniques of oral communication as used in typical banking situations, knowledge of bank policies and practices by the employees, the level of satisfaction of bank personnel with company communication practices, and reactions of both customers and noncustomers toward the bank's "external" communications.

II. Methodology

The research methods which were used may be listed as follows:

A. Internal Communications.

1. Employee Questionnaire. A questionnaire of thirty

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items was devised, covering: (1) accuracy of information about bank policies possessed by the employees, (2) employee morale, and (3) communication satisfaction. Forty-nine employees (out of a total population of fifty-four) completed the questionnaire.

2. Observation. All important banking situations involving interpersonal communication were observed by the writer.

3. Employee Interviews. Forty-five employees were interviewed. Each interview covered such topics as: channels of communication; means, places, and persons available for expressing complaints; message flow; information about changes in policy, etc.

4. Supervisory Interviews. Five of the seven supervisors were interviewed, at length. While some questions included in this interview were similar to those used with the employees, others were added to probe topics appropriate to the supervisory level.

5. Officer Interviews. All five officers were interviewed; such topics were included as: communication aspects of decision making, channels of communication, and methods of "upward" message flow.

6. Grapevine Survey. A written questionnaire was used in an effort to learn something of the operation of the "grapevine."

7. Examination of Printed Materials. An examination was made of such items as the employee handbook and the employee newspaper.

B. External Communications.

1. Customer Interviews. Twenty-five customers of the bank were interviewed for the purpose of gaining some feedback concerning the bank's external communications.

2. Non-customer Interviews. Twenty-one non-customers of the bank were interviewed to determine their reactions to the bank's external communications.

3. Observation of Employee-Customer Communication Situations. The writer observed various situations involving bank personnel and the public.

III. Treatment of Data

Data were analyzed in the light of hypotheses, derived from contemporary communication theory. Questionnaire data were subjected to correlational and comparative analyses of various kinds; interview, observational and documentary data were presented essentially in non-quantitative terms.

IV. Conclusions

The most important conclusions were:

1. Nine hypotheses were postulated concerning basic requirements for effective internal and external communications in a business organization; with one exception, these were confirmed for the First National Bank of [Midcity].

2. The evidence did not substantiate the hypothesis that management must have well defined communication policies in order that the internal communication program be a reasonably successful one.

3. In spite of a fairly affective communication program, the employees' information about bank practices and policies was only mediocre. There was widespread ignorance, for example, about such matters as insurance benefits.

4. The hypothesis was confirmed that, by and large, employees prefer the oral and more personalized media of communication to the written or impersonal.

5. Problem areas in internal communications were apparently most likely to occur in (a) stimulating "upward" flow of ideas, suggestions, and complaints, (b) handling reprimands and complaints, and (c) appraising job performance.

6. Some commonly accepted assumptions about communication were seriously questioned; for example: a large group of employees depending largely upon the grapevine for information seemed to suffer no ill effects (regarding information, morale, or "communication satisfaction").

7. No significant correlations were discovered between level of information and employee morale, or between level of information and communication satisfaction. A moderate correlation was found between communication satisfaction and morale.

8. External communications of the bank, with both customers and non-customers, were found to be excellent.

9. An effective internal communication system is probably prerequisite to, but certainly no guarantee of, business success.

Microfilm $5.60; Xerox $19.60. 432 pages.

THE DEVELOPMENT AND APPLICATION OF PROCEDURES FOR MEASURING SPEECH IMPROVEMENT IN MENTALLY DEFECTIVE CHILDREN

(L. C. Card No. Mic 59-5434)

Merlin J. Mecham, Ph.D.
The Ohio State University, 1954

Since the public schools are currently accepting the responsibility for instructing many mentally defective children and many of them are referred for speech therapy, there is a need for adapted tests to aid in (1) selecting and grouping the cases, and (2) evaluating both the progress of the cases and the relative effectiveness of different training techniques.

The purposes of the present study were (1) to develop tests that would measure selected aspects of speech in mentally defective children, and (2) to employ these tests in appraising some effects of a program of speech therapy among mentally defective children. Four attributes of speech were considered: articulation, discrimination, memory span, and specific phases of oral language development. These four attributes were stressed during eight weeks of speech therapy with mentally defective school children.

A description of the four tests follows. The test of articulation was comprised of nonsense monosyllables that were consonant-vowel-consonant combinations. The consonants were common among the lists of three relevant studies,[1,2,3] the first two of which reported these consonants to be among the most frequently defective sounds of the speech of mentally deficient children, and the third listed them among the sounds that significantly affect intelligibility. The vowels and diphthongs that were employed were also enumerated in this third study as being

of consequence in determining intelligibility. The consonants, diphthongs and vowels were: [p], [k], [g], [tʃ], [dʒ], [ʃ], [ɵ], [v], [s], [l], [ɪ], [æ], [ɔ], [aʊ], [ɔɪ], and [ou].

The method of constructing the syllables for the test of articulation was the one used by the Bell Telephone Laboratories in developing items for articulation tests.[4] Ten syllables, so constructed, were recorded on magnetic tape and played back through earphones to the experimental subjects, who, in turn, repeated the syllables. These repeated items were recorded for presentation to a panel of judges.

The Templin Short Test of Speech Sound Discrimination had been found to be unsatisfactory in testing mentally defective children.[5] Sound discrimination ability, however, was considered to be a desirable topic of a test; hence, a test of auditory discrimination was constructed that used familiar and concrete materials. The procedures in constructing the test resembled those used in constructing intelligibility tests intended for application with military personnel.[6] The discrimination test requires a word-picture matching response on the part of the subject who hears and identifies the word that names a picture. With each item of the test the subject sees a 5" x 8" card on which are mounted three pictures, and hears simultaneously three recorded words through earphones. One of the words is the name of one picture on the card. (The other two words are acoustically similar to the names of the other two pictures on the card.) The subject points to the picture that matches one of the three words. For example, he might see pictures of "feet—sun—money" and simultaneously hear "seat—fun—money." He would be expected to point to the picture of "money," named correctly in the item.

Two-hundred pictures the names of which appear within the 2,000 most frequent words in the Thorndike list[7] were included in the preliminary form of the test; these pictures had been published for use in speech therapy for young children. Two pictures that matched each name were secured. Three pictures, selected randomly from the total, were arranged in random order on each of 132 cards. These cards were the visual stimuli. The names of the 200 pictures were part of the auditory stimuli. Each name, however, was assigned and paired with a "similar" word. The "similar" words were ones that were suggested by 25 experienced speech and hearing therapists as likely mistakes or confusion responses by children upon repeating the stimulus words. One of the pictures on each card, the position of which was chosen in a random fashion, was assigned its correct name and the other two pictures were labeled their corresponding "similar-word" names. Thus, the remaining portion of the auditory stimuli was comprised of "similar-words."

Auditory stimuli for each card were in the order of the three positions, left to right, e.g., "seat—fun—money."

The discrimination test was given to 40 mentally defective children and an item analysis was made of their responses. Items that exceeded 85 per cent and ones that were less than 15 per cent correct were discarded as not being discriminating. (The discarded "easy" items became practice items.) Of the original 132 items, 86 were included in the final test. Each of three speakers read conversationally one-third of the words of the auditory stimuli, inserting a three-second pause between three-word groups. The auditory stimuli were recorded on magnetic tape for playback as the listener simultaneously viewed the visual stimuli.

An auditory digit memory-span test was constructed in a conventional manner using the one-syllable digits. Combinations of digits in each item were selected randomly, provided (1) no consecutive numbers fell together and (2) no number appeared in an item more than once. There were 16 items of four lengths, with the number of digits per item ranging from two to five (four items contained two digits, four contained three, four contained four, and four contained five). The items were arranged randomly and recorded on magnetic tape. There was a one-second pause after each digit in an item and a ten-second pause between items.

The test of oral language development merely consisted of stimulus pictures and questions designed to elicit oral verbal expression from children—materials to be recorded and analyzed according to average sentence length, type-token ratio, and frequency of grammatical parts of speech. The 10 pictures in the Children's Apperception Test, depicting animals in various situations, were employed. Five questions, intended specifically to increase the quantity of the child's verbal responses, accompanied the pictures: (1) What do you see on this picture? (2) Will you tell me a story about this picture? (3) What's happening? (4) What else? (5) Can you tell me more about that? The examiner used the questions at will.

The four tests were administered to three groups of experimental subjects, all mentally defective children enrolled in special education classes at the Columbus State School. The experimental group, consisting of 21 children, was tested before and after a period of speech therapy. The second group, a control group of 10 randomly chosen children from the same classes as the subjects in the experimental group, was tested at the same time as the experimental group. The third group, a match group of 10 children who were matched with the experimental subjects in C.A., I.Q., and sex, was used later during a retesting period as a check on the stability of the testing procedures and equipment.

The testing time for each subject was approximately 45 minutes. The testing relative to each stage of the study occurred within a week. Time of day, day of the week, the position of a subject relative to the equipment and the experimenter were constant from one stage of the study to another. The testing occurred on the top floor of a three-story building. The room, although not constructed to meet any acoustical requirement, tended to be sound absorbent and was out of range of noticeable extraneous noises.

An Ekotape tape recorder, Model 116, was used to reproduce the auditory stimulus materials. The stimuli for the articulation test were heard through earphones and the stimuli for the auditory discrimination and memory span tests were heard through the loud speaker of the recorder-reproducer. The subjects' oral responses on the articulation test were picked up by a Western Electric dynamic microphone, Model 633, and fed to a Magnecorder tape recorder, Model PT 6-A. Samples of connected discourse of the subjects for the measurement of oral language development were picked up by a dynamic Electro-voice microphone, Model 630, and fed to an Ekotape tape recorder. Five judges, who transcribed the recorded nonsense-monosyllable responses of the subjects phonetically, listened to the material as played back on the

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Magnecorder tape recorder through a "voice of the Theater" (Altec-Lansing) speaker.

The eight-week program of speech therapy was given by two speech therapists employed at the Columbus State School and included both individual and group instruction. In three therapy sessions per week the clinicians tried to accomplish: (1) improved articulation, (2) improved auditory discrimination, (3) increased auditory memory span, and (4) further oral language development. Specific techniques for achieving these goals were left to the therapist's discretion; however, routine procedures in speech therapy with elementary school children were planned,[8] and there was close cooperation between the therapists and the experimenter.

After eight weeks of speech therapy, the subjects in the experimental and control groups were retested, and the subjects in the match group were tested for the first time.

Split-half coefficients of correlation (r) were obtained on the tests of auditory discrimination and auditory memory span using the odd-even scores of the 31 subjects of the experimental and control groups. With the tests of articulation and oral language development, test-retest scores were correlated (r). The scores of the 10 subjects in the control group were used to obtain the test-retest reliability coefficients since they had been tested and later retested without any intervening speech training. The split-half reliability coefficients were .95 for auditory discrimination, and .95 for auditory memory span. The test-retest reliability coefficients were .92 for articulation, and .46, .14, and .97 for average sentence length, type-token ratio (TTR), and mean frequency of grammatical parts of speech, respectively. Estimates of the relationships among the tests are presented in Table I, a matrix of the intercorrelations of the four tests (including two subtests of language development) and of the tests with I.Q. and C.A. Correlations between three pairs of the variables were significant at the 1 per cent level of confidence: (1) auditory word discrimination vs. auditory digit memory span, (2) C.A. of the subjects vs. test of auditory digit memory span, and (3) articulation vs. I.Q. of the subjects. The correlation between the I.Q. of the subjects and the average sentence length was significant at the 5 per cent level of confidence.

An "analysis of variance" among the tests using X_r^2 was calculated.[9] Test ranks based on Z scores of the subjects within each test distribution were used in the analysis. The resulting X_r^2 of -13 is significant at the 1 per cent level of confidence. This indicates that in general the tests measure different characteristics. Changes in speech proficiency as a result of therapy were tested by a series of t-tests. The results are summarized in Table II. The subjects in the experimental group showed statistically significant improvement in articulation, auditory discrimination, and auditory memory span. There was also significant increase in their average sentence lengths. The subjects in the control group showed significant improvement in the test of auditory memory span at the 5 per cent level of confidence. There were no significant differences between the initial scores of the subjects in the control group and the scores of the subjects in the match group. This would indicate that the procedures of testing were the same at the two principal times of testing.

TABLE I

INTERCORRELATIONS OF SEVEN MEASURES RELATED TO SPEECH

	Auditory Discrimination	Auditory Memory Span	TTR	Average Sentence Length	Articulation	I.Q.	C.A.
Auditory Discrimination	.50†	.08	.13	-.19	.11	.34	
Auditory Memory Span		.26	.35	-.12	.29	.51†	
TTR			-.35	.06	-.04	-.05	
Average Sentence Length				.10	.42*	.18	
Articulation					.48†	-.32	
I.Q.						-.30	
C.A.							

*With N of 29, a value of r of .37 is significant at the 5 per cent level of confidence,

†With N of 29, a value of r of .48 is significant at the 1 per cent level of confidence.

TABLE II

THE SCORES OF THE EXPERIMENTAL SUBJECTS ON THE TESTS OF ARTICULATION, AUDITORY DISCRIMINATION, AUDITORY MEMORY SPAN, AND AVERAGE SENTENCE LENGTH, BEFORE AND AFTER TRAINING

Group	N	Test	Mean Score Initial	S.D.	Final	S.D.	t
Experimental	20	Articulation	53.56%	21.7	60.22%	24.9	3.5**
	20	Discrimination	64.40%	15.2	72.20%	18.9	2.8*
	21	Memory Span	4.20%	4.2	49.90%	3.7	3.9**
	21	Av. Sentence L. (in words)	4.12	2.2	6.02	2.8	4.4**
Control	10	Articulation	78.79%	24.5	77.85%	23.5	.9
	10	Discrimination	66.20%	10.9	74.60%	15.4	1.7
	10	Memory Span	50.60%	3.3	60.00%	2.5	2.9*
	10	Av. Sentence L. (in words)	5.01	1.3	4.58	1.3	.9
Control vs. Match	10	Articulation	78.79%	24.5	77.49%	31.0	.4
	10	Discrimination	66.20%	10.9	70.20%	19.0	.5
	10	Memory Span	50.60%	3.3	48.70%	3.5	.2
	10	Av. Sentence L. (in words)	5.01	1.3	5.73	2.1	.8

* t, significant at the 5 per cent level of confidence.
** t, significant at the 1 per cent level of confidence.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Correlations between the improvement scores of the subjects and I.Q. and C.A. appear in Table III. The only significant correlation occurred in the instance of C.A. vs. auditory discrimination.

TABLE III

MATRIX OF PEARSON PRODUCT-MOMENT COEFFICIENTS OF CORRELATION OF AMOUNT OF IMPROVEMENT ON EACH OF THE TESTS WITH I.Q. AND C.A.

	Auditory Discrimination	Auditory Memory Span	TTR	Average Sentence Length	Articulation
I.Q.	-.18	.08	-.09	.13	.02
C.A.	.57*	-.36	.06	.28	-.02

*r of .46 is different from zero at the 5 per cent level of confidence, N=19, (r of .60 is different from zero at the 1 per cent level of confidence).

The results of the study imply that the tests of articulation, auditory discrimination, and auditory memory span were sufficiently reliable for the measurement of aspects of the speech of mentally defective children. Evidently the tests of auditory discrimination and auditory memory span were not independent of each other.

Significant improvement as a consequence of speech therapy was measured in articulation, auditory discrimination, auditory memory span, and average sentence length. This improvement was independent of I.Q., although the improvement in auditory discrimination was not independent of C.A. Subjects who did not receive therapy made no significant improvement during the experimental period except in the instance of auditory memory span, suggesting that adaptation or learning took place in this ability during the testing procedures.

Microfilm $2.50; Xerox $6.80. 142 pages.

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Abstract published by special arrangement with The Ohio State University.

A DESCRIPTION AND ANALYSIS OF THE SPEAKING IN THE LOUISIANA ANTI-LOTTERY MOVEMENT

(L. C. Card No. Mic 59-5523)

Joseph Charles Mele, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Owen M. Peterson

This work is a rhetorical analysis of the speakers, audiences, occasions, and speeches which made the Louisiana Anti-Lottery Movement successful in spite of overwhelming opposition from a wealthy and politically strong gambling monopoly known as the Louisiana State Lottery Company.

Texts of speeches for the study came from an anti-lottery newspaper, the New Orleans New Delta; a pro-lottery newspaper, the New Orleans Daily Picayune; and from the Official Proceedings of the Anti-Lottery Democratic Convention, 1890. Further information came from general reference works, histories, government publications, periodicals, personal correspondence and manuscripts.

From 1869 through 1892 the Louisiana State Lottery Company was the cause of political unrest. With millions of dollars in assets this giant gambling monopoly all but controlled the state economically and politically. Its corrupting influence extended to the legislature and courts. In 1879 an unsuccessful attempt to cancel the Lottery charter left the concern with more power than it originally had. The Lottery charter was to expire January 1, 1894; however, its managers decided to attempt to get a twenty-five year renewal in spite of the fact that the constitution forbade lotteries after 1895. A storm of protest arose from many of the responsible leaders in the state. By mid-1890 the Anti-Lottery League had been formed by a group of lawyers, politicians, judges, preachers, and merchants. Through the League members, a statewide public speaking campaign was carried on. Many notable Louisianians including Murphy J. Foster, Edward Douglas White, Donelson Caffery and the Rev. Benjamin Morgan Palmer participated as orators for the anti-lottery cause.

In 1891 the anti-lottery crusade merged with the gubernatorial campaign. The central issue was whether the Lottery should be rechartered. Both sides placed their arguments before the voters. Mass meetings took place with bands, barbecues, and grand balls as added attractions. From the farmlands and from the city streets hundreds, and at times thousands, came to participate in the colorful and lively campaign. They cheered, applauded, and encouraged the orators to speak. Gradually the anti-lottery faction gained strength, mostly from the rural parishes, and victory was in sight.

Debate was at a heated pitch with the anti-lottery advocates claiming that the Lottery (1) dominated the state

politically, (2) offered a financially poor contract for a multi-million dollar business, and (3) was an immoral institution. The Lottery backers claimed that the state could not meet its financial obligations without the million and a quarter per year offered by the Company. Each side offered evidence to prove its case, with the anti-lottery group doing the better debating.

In April of 1892 the people of Louisiana went to the polls and gave a winning plurality to the anti-lottery candidate, Murphy J. Foster, and rejected the proposed Lottery charter renewal amendment.

The Anti-Lottery League used the force of the spoken word to defeat a powerful and wealthy foe which had over ninety per cent of the state press supporting its recharter amendment. This study is a tribute to the democratic process of government which allows for discussion, debate, and orderly change, according to the wishes of the majority, exercised through a free ballot.

Microfilm $2.55; Xerox $8.80. 195 pages.

A STUDY OF THE PREACHING AT THE OCEAN GROVE, NEW JERSEY, CAMP MEETING, 1870-1900.

(L. C. Card No. Mic 59-5524)

Charles A. Parker, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Waldo W. Braden

The purpose of this study is to describe, to report, and to evaluate the trends in the preaching at Ocean Grove Camp Meeting, New Jersey, from its inception in 1870 until 1900. The study traces the origin and development of the camp meeting from the frontier revival to the vacation camp meeting of the post Civil War period. It reconstructs physical setting for public speaking, analyzes audiences, identifies preachers, and discusses overall characteristics of the preaching.

Congregations at Ocean Grove numbered from 2,000 to 14,000 three times daily, for ten consecutive days annually. Although people came from all parts of the United States, and from foreign lands, most lived in urban areas of the Middle Atlantic states. All ages, many denominations, several races, varied economic and social levels, and often a majority of women, attended. An inherited, largely unquestioning belief in religion was common.

Many of the most prominent Methodist bishops, educators, ministers, and evangelists, as well as representatives from other denominations, preached at the main services. Speakers were specially invited, or selected from the hundreds of clergymen already on the grounds. Manuscript delivery was common, but extemporaneous speaking predominated.

Analysis of 137 lengthy sermon synopses revealed twenty-five devoted to entire sanctification or holiness; forty-two to salvation, and seventy to inspiration. Analysis of shorter materials, totalling 576 sermons, indicated that this ratio was representative.

Based upon five major premises, the sermons concerning holiness had similar lines of argument, but utilized the following six common arguments to support the doctrine: first, sanctification cleanses from the effect of Adam's original sin; second, it tends to keep one from further sinning; third, it inspires fearlessness; fourth, the sanctified possess special powers; fifth, scholarly knowledge is not necessary to understand God; and sixth, that the people were lax in seeking sanctification.

Salvation preaching sprang from five assumptions, and followed five argumentative lines: fifteen sermons dealt with procrastination; six with reward; three with judgment and punishment; four with faith; three with exposition of God's plan of salvation; and eleven with miscellaneous lines of development.

Inspirational sermons emanated from one broad and six specific premises, taking six chains of argument: fourteen discussed Christ's dominance; eight, the advance of Christianity; eight, reaffirmation of faith; twenty-four, application of Christian principles and duties; two, the lives of saints; three, regeneration; and eleven could not be classified.

Results of the preaching on entire sanctification and on salvation were probably insignificant, primarily because of the type of audience, and because of suppressing environmental conditions. Inspirational sermons, however, were probably more successful.

Three broad conclusions are suggested. First, that the preaching was highly popular, but limited largely to the discussion of fundamental religious themes that constituted a conservative defense against liberal theological thought. Second, the season's cultural and theological program at the religious resort actually constituted a summer-long camp meeting, rather than a short evangelistic campaign. Third, the vacation camp meeting was distinctly different from the woodland revival of the early decades of the nineteenth century. Convenient, orderly, comfortable, but generally inspiring services had made it a sophisticated, ritualized form of the original camp meeting. Microfilm $3.95; Xerox $13.40. 308 pages.

THE PHILOSOPHY OF AMERICAN RHETORIC AS IT DEVELOPED IN THE BOYLSTON CHAIR OF RHETORIC AND ORATORY AT HARVARD UNIVERSITY

(L. C. Card No. Mic 59-5869)

Paul Eugene Ried, Ph.D.
The Ohio State University, 1959

The Boylston Chair of Rhetoric and Oratory at Harvard University was established in 1806 as a result of the bequest of Nicholas Boylston Esq. The development of the philosophy of rhetoric in the Boylston Chair has been characterized by lack of consistency. This was apparent after a detailed analysis of the rhetorics of John Quincy Adams, Joseph McKean, Edward Tyrrel Channing and Adams Sherman Hill, and after an investigation into the interests of six other holders of the Chair who did not publish in organized form a "rhetoric."

Emphasis has shifted from oral to written communication, from invention to grammar and style and from classical rhetoric to modern poetics. These changes in emphasis over a period of a hundred and fifty-three years resulted from the fact that each individual

occupant of the Chair defined rhetoric to include his own interests.

The interests and educational backgrounds of John Quincy Adams (1806-1809) and Joseph McKean (1809-1818) were such that the original rules for the Chair, which were based on John Ward's concept of classical rhetoric, were amenable to their point of view.

Edward Tyrrel Channing (1819-1851) developed his definition of rhetoric to include his basic interest in writing. This led to an emphasis on written communication and to a neglect of the spoken word.

Francis J. Child (1851-1876) did not try to fit his definition of rhetoric into the original rules of his office. He changed the name of his duties from Lectures on Rhetoric and Oratory to Lectures on Rhetoric and English Composition and devoted his energies to philology, specifically work in English and Scottish ballads.

Adams Sherman Hill (1876-1904) redefined rhetoric, eliminating all of the classical canons except the one pertaining to his particular interest - style in written composition. He defined rhetoric as grammar, and his standard for judgment was correctness.

Le Baron Russell Briggs (1904-1925), who received his early years of training under Hill, was content to build his teachings on precedent established by Hill. Charles Townsend Copeland (1925-1928) made his name in oral reading and continued for his three years in the Chair to teach literature through oral interpretation.

The last three occupants of the Chair, Robert S. Hillyer (1937-1944), Theodore Spencer (1946-1949) and the present incumbent, Archibald MacLeish (1949-), have defined their function as Boylston Professor in terms of poetry.

Two specific attempts have been made by the administration of Harvard to restrict the work of Boylston professors. The first attempt to prescribe rules was in the form of the original rules of the Chair, written by Eliphalet Pearson in 1804. Gradually these rules were forgotten. President Eliot's policy was the second attempt to fashion teaching in the Boylston Chair. Eliot's changes in policy were not permanent.

The Boylston Chair at Harvard University set the pace for education in rhetoric on a national basis until 1900. Insofar as speech education of recent years is concerned, Harvard's direct influence today through the Boylston Chair is negligible.

Microfilm $4.30; Xerox $6.40. 335 pages.

THE NEW YORK LEGISLATIVE CAMPAIGN SPEAKING OF GOVERNOR CHARLES EVANS HUGHES, 1907-1910.

(L. C. Card No. Mic 59-5525)

Mary Margaret Roberts, Ph.D.
Louisiana State University, 1959

Supervisor: Professor Waldo W. Braden

This study is a rhetorical analysis of Charles Evans Hughes' three major legislative campaigns as governor of New York from 1907 to 1910. Elected as the people's champion against special interests after his successful gas and life insurance investigations of 1905 and 1906, he sought to effect the Progressive reforms he felt the citizens demanded. When he found the political leaders opposed to change, he appealed to the people for support.

This study analyzes Hughes' rhetorical enterprise as exemplified by the campaigns to obtain legislation for three purposes: (1) to establish State public utilities regulation, (2) to implement anti-racetrack gambling laws, and (3) to institute direct primaries. Chapter One considers his qualifications for leadership through speech. Chapter Two develops the climate of the times in which he spoke. Chapter Three discusses his philosophy of government, comparing and contrasting his approach with that of other Progressives. Chapters Four, Five and Six analyze his speech methods in the respective appeals. Chapter Seven appraises his influence as a speaker.

Fifteen speeches selected for their special rhetorical and political importance form the basis for detailed analysis of the campaigns. The following factors receive special attention: the nature of the political-rhetorical problem, the provisions of the bills, the characteristics of the occasions, the arguments and evidence, the emotional and ethical appeals, organization, style, and effect.

A principal source of material for the study was the Hughes Papers deposited in the Manuscripts Division of the Library of Congress. This collection consists of Hughes' Biographical Notes, memoranda summaries of important events in Hughes' career prepared by Henry C. Beerits, documents, correspondence, yearbooks, scrapbooks, newspaper and magazine articles, and an address file. Another principal source was the New York City Public Library, which furnished the following: (1) the private papers of George C. Agnew, a sponsor of the anti-racetrack gambling bills; (2) the Hughes collection which contains what apparently constitutes the largest and most authentic file of the Governor's speeches, and correspondence and printed material on campaign issues; and (3) the Fuller collection of several hundred scrapbooks filled with newspaper clippings of the Chief Executive's accomplishments.

Ethical proof was important in Hughes' persuasion. His antecedent reputation contributed to the confidence the people felt in him, and skillful ethical appeals in his speeches helped to reinforce his authority. His reputation repelled the party leaders, and his public repudiation of their power completed the alienation.

Combining his strong ethical appeal with powerful logical and worthy emotional appeals, he obtained passage of the public utilities and anti-racetrack gambling bills; he contributed to eventual acceptance of the principle of direct nominations. He won so much support for his political philosophy of efficient, responsible, "unbossed" government carried on through enlightened public opinion that several subsequent governors in New York and outside the State found it expedient to promise to follow his example. Particularly because of measures like the Moreland Act which supplied a legal basis for increased efficiency and enlarged executive responsibility, he is credited with achieving a long-range effect upon State government.

While he did not produce speeches of great individual artistic merit, he did contribute a body of speeches which presented an impressive case for his idea of government. He did help to reveal the significant role speechmaking can play in the historical process. He did so by

demonstrating that public opinion can influence State government when an able governor, skilled in speaking, chooses to enlighten and to appeal to the voters.

Microfilm $4.70; Xerox $15.60. 365 pages.

A HISTORY OF THE DEVELOPMENT OF THE EDUCATIONAL THEATRE IN NEGRO COLLEGES AND UNIVERSITIES FROM 1911 TO 1959

(L. C. Card No. Mic 59-5527)

Floyd Leslie Sandle, Ph.D.
Louisiana State University, 1959

Supervisor: Professor C. L. Shaver

For an understanding of the development of the educational theatre in Negro colleges and universities during the period 1911-1959, it is first necessary to describe the general growth of Negro educational institutions of higher learning which gave rise to the widespread development of the educational theatre in these institutions. This study has concerned itself with the rise of the Negro college and university; the pioneers in the movement toward a Negro theatre; and with the Southern Association of Dramatic and Speech Arts, which organization has, for the most part, served as the pioneer dramatic organization among Negro educational institutions in the movement to develop a functional educational theatre.

In 1911, the first organization in dramatics in a Negro college was founded at Howard University in Washington, D. C. But it was not until 1930 that the first Negro educational theatre organization, The Intercollegiate Dramatic Association, was founded by Randolph Edmonds. Five years later, in 1935, the second dramatic organization, The Southern Association of Dramatic and Speech Arts, was organized by the same man. Both were based on the theory that the hope of the genuine Negro theatre is to be found in the organizational approach in Negro colleges.

This study analyzes the influence of pioneer playwrights and actors on the development of the Negro theatre; surveys the work of the Southern Association of Dramatic and Speech Arts as a factor in the development of the educational theatre in Negro colleges by summarizing philosophies, procedures and problems as indicated in the association's publications; and traces the growth of the curriculum in speech and drama in Negro colleges and universities. Microfilm $4.00; Xerox $13.40. 310 pages.

THE RHETORIC OF ZEBULON B. VANCE: TARHEEL SPOKESMAN.

(L. C. Card No. Mic 59-6110)

Franklin Ray Shirley, Ph.D.
The University of Florida, 1959

The purpose of this study was to give a chronological view of the public speaking of Zebulon B. Vance, one of North Carolina's favorite sons, and most popular orator, and to make an analysis and evaluation of the effectiveness of his speaking. After investigating the influence of his background and training on his speaking, a consideration was given to his speaking as a youthful politician and lawyer, a Civil War governor, a candidate in two famous gubernatorial campaigns, a speaker in the post-war period, a third-term governor, and an occasional speaker and lecturer. Representative speeches were selected from each of these divisions for analysis and evaluation. The main sources of this study were letters, newspapers, diaries, the Congressional Globe, the Congressional Record, manuscripts, published lectures, and the usual secondary sources such as historical works and biographies.

From his family, Vance was found to have inherited intelligence and acquired a good character, both of which are essential to the effective speaker. Although his education was meager, what formal education he had provided him with speech training. Washington College, which he attended for one year, required him to declaim each week in a style that was free from ornamentation and slovenliness. At the University of North Carolina, where he spent one year studying law and classical subjects, he received training in rhetoric and logic.

Vance's forte was his stump speaking. His early political speeches demonstrated wit, humor, and a boisterous eloquence which were appreciated by the unlettered farmers comprising his audiences. The chief weakness of his early campaign speaking was his impulsive nature, which often caused him to respond without tact or judgment to his opponent's charges. This impetuosity may be attributed to his immaturity since he was only twenty-four years old during his first campaign. In later years he demonstrated remarkable control in some extremely bitter debates.

While Vance sometimes read his speeches from manuscript or spoke impromptu, his most significant speeches were those delivered extemporaneously. His speeches in the Senate and his popular lectures were usually extemporaneous while his speeches on the hustings were almost entirely impromptu. His principal addresses were prepared with great care, and studied thoroughly for delivery.

In their overall development, Vance's speeches were well organized and substantially supported. His supporting materials were testimony, statistics, illustrations, and specific instances. Although Vance used logical support, he constantly sought to win response through motive appeals. He also used ethical appeal to good advantage. However, humor was his chief method of gaining a favorable response from his audiences. Sometimes he showed poor taste in using vulgar, dirty, and common language, but his use of the language of the street was as a means to an end.

Vance's subjects were as varied as the years in which he spoke, but whatever the issue he was first, last, and always for North Carolina. He is not recognized as one of America's greatest orators, but he will always be considered North Carolina's greatest. If his speaking is measured by the honors bestowed upon him by North Carolina, and by the speeches he made over a period of forty years of public service, 1854 to 1894, he must be ranked high among southern orators.

Microfilm $5.25; Xerox $18.70. 411 pages.

AN INVESTIGATION OF THE HEARING ENVIRONMENT OF SCHOOL AGE HEARING IMPAIRED CHILDREN

(L. C. Card No. Mic 59-6514)

John Arthur Sills, Ph.D.
Purdue University, 1959

Major Professor: Dr. G. L. Shaffer

The purpose of this study was to survey the hearing environment of school age, hearing impaired children as reflected by the opinions of the pupil, his teacher and parent. The study utilized 68 hearing-handicapped, school age subjects divided into four groups.

Group I: Twenty public school pupils with a B.E.A. hearing loss ranging from 20 to 30 db.

Group II: Eighteen public school pupils with a B.E.A. hearing loss in excess of 30 db.

Group III: Twenty pupils attending the Indiana State School for the Deaf.

Group IV: Ten hearing handicapped, familial, mentally retarded children attending the school unit of the Fort Wayne State School.

The pupil, the teacher, and parent, each were interviewed in an attempt to ascertain the pupil's behavior in his hearing environment. The interview questionnaires were constructed from behavior items reported as being clinically observed behavior symptoms of hard-of-hearing children. The interview technique employed was similar to the one described by Kinsey, Pomroy and Martin (48). The interview responses were tabulated and examined for trends in behavior. Twenty-three hearing-behavior items that were common to at least two of the three interviews were selected. These items were analyzed for statistically significant differences among groups. They were also analyzed for differences between school-home environment and male-female hearing behavior. The single classification analysis of variance and the t-test statistical technique were employed.

Within the limitations imposed by the experimental procedure, the following conclusions are drawn:

1. The hypothesis that there were no statistically significant differences of hearing behavior among the four groups was not rejected.
2. The hypothesis that there was no statistically significant differences between the school-home hearing environment of public school pupils was not rejected.
3. The hypothesis that there was no statistically significant difference between public school male-female hearing behavior was not rejected.

The following behavior trends seem worth noting:

1. Group III pupils tended to have less difficulty in their hearing environment than pupils from the other three groups.
2. The Fort Wayne State School pupils tended to have their hearing handicaps minimized.
3. The public school pupil, parent, and teacher interviews seemed to indicate that: Group I pupils had the most difficulty in school. Group II pupils had the most difficulty at home.
4. The teachers and pupils of Group I suggested that these pupils appeared to be inattentive and tended to ignore verbal directions. The parents did not recognize this.
5. Group II parents recognized that their children were inattentive and ignored verbal directions.
6. Group II students, being more severely handicapped, failed to answer when spoken to and quite often misunderstood what was asked them.
7. The parent and teacher interviews of Group II pupils suggested that these pupils tended to use more extreme behavior patterns.
8. Group I pupils tended to have a greater incidence of earaches while Group II pupils tended to have a greater incidence of running ears.
9. The interview responses seemed to indicate that the pupil was most aware of his hearing handicap. The teacher seemed to recognize the handicap first. The parent did not seem to recognize the handicap until the hearing loss had reached Group II proportions. Microfilm 2.65; Xerox $9.25. 203 pages.

THE APPLICATION OF PREVAILING PRINCIPLES OF ELOCUTION TO THEATRICAL CRITICISM OF AMERICAN ACTING: 1815-1840.

(L. C. Card No. Mic 59-6112)

Charles McCorkle Statham, Ph.D.
The University of Florida, 1959

This is a study in acting styles and techniques which were current on the American stage between 1815 to 1840. In order to recreate the acting styles of the era, the study examined theatrical criticisms written by critics for the periodicals in the theatrical and publishing centers of the nation, New York, Boston, and Philadelphia. To explain the terms which critics used, and the standards they followed, the works on elocution which were widely used in the period were studied to determine the "patterns of communication" which these writers described as guides for the delivery of public speakers, oral readers, and at times actors. The theatrical criticism was then analyzed in terms of these "patterns."

When the theatrical criticism of the period was examined, it was found to deal mainly with the actor and his technique. Very little attention was given to the plays themselves, since the audiences were familiar with the standard repertory which was presented over and over. Audiences did not go to the theatre necessarily to see the plays, but to watch a virtuoso performance by an actor. This kind of interest placed the attention squarely on the actor, the exhibition which he made of his talents, and the technique by which he accomplished his effects. The items of major concern to critics and audiences of that day were the actor's pronunciation of words, his use of

voice, the way he used his body, the manner in which he expressed emotion, and how he achieved a "fidelity to nature."

Results of the study show that this method has some advantages. Applying to eye-witness accounts by contemporary writers of a given period the "patterns of communication" current at the time allows the student to visualize more clearly what it was the actor did when performing and to describe more exactly the components of a particular style. The study demonstrates the thesis that the labels placed on acting styles must be interpreted within the framework of conventions of a particular period. Actors, for instance, who have been traditionally called "natural" were found to perform with many characteristics of the "formal" actor. The actors, moreover, who apparently employed more verisimilitude in their portrayals were not acclaimed over the conventional performer. The study shows that many of the patterns of voice and bodily activity followed by the actors were conventional. Critics seemed unable to isolate completely the "natural" from the "formal" actor and labeled as "natural" what appeared to them to be accomplished with such ease and grace that it seemed to be the natural result of the actor's spontaneous thought and feeling.

Microfilm $2.50; Xerox $8.40. 183 pages.

THE EFFECTS OF MOTIVATING INSTRUCTIONS ON THE LANGUAGE PERFORMANCE OF DYSPHASIC SUBJECTS

(L. C. Card No. Mic 59-5738)

Margaret Love Stoicheff, Ph.D.
State University of Iowa, 1959

Chairman: Associate Professor Frederic L. Darley

Some writers in the field of dysphasia have stated that language performance is dependent solely upon the extent and location of the brain damage. Others have argued for a functional or psychological component in the symptomatology of dysphasia.

The present study was an attempt to determine whether the language performance of dysphasic subjects is dependent upon factors other than the damage to the brain. The approach selected for investigation was that of manipulating the motivational variable by instructions and noting the effects on language performance.

Forty-two dysphasic subjects, 30 males and 12 females ranging in age from 18 to 80 years, selected on the basis of their ability to perform within set limits on a preliminary Reading or Naming task were randomly assigned to one of three motivating instructions groups, "encouraging," "discouraging," or "non-evaluative." Each subject spent three sessions (two practice and one experimental) under one of these conditions with the same experimenter. The instructions for each subject within an instructions group were standard. The final (experimental) session was tape-recorded for analysis.

Two factorial analyses were carried out using the number of incorrect responses as the criterion measure in one analysis and the mean latency of correct responses in the other analysis. In addition, each subject rated his performance on a five-point scale.

The following results were obtained:

1. The subjects made significantly more errors on the Reading and Naming tasks under discouraging instructions than under encouraging instructions.
2. Under non-evaluative instructions the subjects made more errors on Reading and Naming tasks than under encouraging instructions, but not significantly more.
3. The mean latencies of the correct responses under the three instructions conditions yielded no significant differences.
4. The subjects under discouraging instructions evaluated their performances less favorably than did subjects under the other two instructions conditions. The most favorable self-ratings were made by subjects in the encouraged group.
5. The self-evaluations of the subjects were reflected in the results of the primary analysis, namely, the number of incorrect responses.
6. A qualitative analysis of the kinds of errors made indicated that the Naming group as a whole made errors of a more serious nature than did the Reading group as a whole.
7. There was an increase in the number of more serious errors under discouraging instructions over the other two instructions conditions for both tasks. This increase was especially marked for the Naming task.

These findings were interpreted as demonstrating a psychological component in the symptomatology presented by the dysphasic individual. The concept of anxiety, suggested by other writers, was postulated to account for the obtained results. The implications of these findings for clinicians and for others associated with the dysphasic individual were discussed in terms of the need for expressing positive attitudes concerning language recovery.

Microfilm $2.50; Xerox $4.60. 89 pages.

A STUDY OF STUDENT SPEECH RECORDINGS

(L. C. Card No. Mic 59-6654)

Norman Coates Webster, Ph.D.
The Ohio State University, 1954

The study was designed to investigate the effectiveness of the disc recording program as a teaching device in the service, fundamentals, and introductory speech sources in the college or university. The major objectives were to secure data which would aid in answering the following questions:

1. Does the teaching device help to increase the student's ability to evaluate speech performance?
2. Does the teaching device help to improve the quality of the student's speech performance?
3. Does the teaching device help to increase the student's interest in the speech course?

The study was carried out in three parts. East part was concerned primarily with one of these basic questions. A different group of subjects was used for each part.

Procedures for Collecting Data on Evaluation of the Speech Act

A questionnaire involving simple questions and rating devices was employed to secure data on some of the

hypotheses. The first question inquired whether the student had heard his recorded voice before. The second asked if the student had had previous speech training. The third and fourth questions, in the form of a graphic rating scale, asked the student, respectively, how he rated his voice as he heard it and how he thought his instructor would rate it. The fifth question presented the student with three choices: did his voice sound as he had expected it to sound, better, or worse? In the sixth question, the same three choices were offered except that the question was directed at the quality of the student's voice at the time the record was made. The seventh question presented fifteen speech faults for the student to identify.

In conjunction with this questionnaire, a two-item questionnaire and rating form was prepared for the instructor. The two questions were the same as questions three and seven of the student question sheet, except that they requested the instructor's opinion of the student's recording.

The student question sheet was filled out by the student immediately after he had heard his recording and before any discussion of the record took place. While the student was filling out his question sheet, the instructor rated and checked the questions on the instructor questionnaire.

The subjects were taken from beginning speech classes at The Ohio State University. Five hundred student question sheets were collected, with the accompanying 500 instructor question sheets.

Procedures for Collecting Data on Improvement of Speaking

This part of the study was designed to investigate the effectiveness of the recording program as a teaching device (A) in improving the student's vocal skill, (B) in improving the student's speech adjustment, and (C) in contributing to the improvement of the student's general speech effectiveness.

Twenty-four judges were selected to be used as evaluation panels for this part of the study. Judging panels were equated and six panels were established, four judges to a panel. The panel ratings were equated and the reliability of the judging panels determined.

The judges used a rating sheet consisting of three graphic rating scales, one dealing with the vocal skill, one with speech adjustment, and one with general speech effectiveness.

To test the hypotheses, it was necessary to select three groups of subjects, all of them to be measured before evaluation or instruction. After the first measurement, varied recording and teaching procedures were used with the first two groups. The third served as a control. The last step was the final measurement.

The first sample, Group I, went through the academic quarter with complete record playback evaluation conferences. Group II followed the same procedure except that no record-playing conferences were carried out. Group III had no contact with recordings at any time during the study. For this group, live speeches at the beginning and end of the quarter were judged by the established judging panels.

Data were collected on eighty-two records from Group I, fifty records from Group II, and first and second speech ratings for forty-seven students in Group III.

The records were randomized. Each side of each record was judged by a different judging panel.

Procedures for Collecting Data on Improvement of Student Attitudes Toward the Speech Class

The study was also designed to discover if the recording program might play a part in increasing or decreasing the beginning college speech student's interest in the speech class itself.

An inventory was prepared with a list of thirty statements about the 401 beginning speech course. Of the thirty statements, twelve referred specifically to some phase of the recording program. The remaining eighteen statements made reference to other aspects of the course, such as quality of teaching and class grading.

The inventories were administered to those beginning classes that were used particularly to test one of the hypotheses. They were administered at the same time the final course examination was given.

Analysis and Results of the Data on Evaluation of the Speech Act

The first step in the processing of this part of the data was the tabulation of the responses to seven questions on the student question sheet and the two questions on the instructor question sheet.

Hypothesis One: The student's evaluation of his own recorded performance reveals no significant agreement with his instructor's evaluation.

The student and instructor were asked to evaluate the student's voice as revealed on the recording. A frequency table of the ratings was made. A product moment coefficient of correlation was computed on these data. The over-all correlation between the ratings of students and instructors was .293. Although the reliability of this correlation was significant at the 1 per cent level of confidence, it was a low correlation and did not warrant rejection of the hypothesis.

Question Seven was answered by both students and instructors. Fifteen speaking faults were listed and students and instructors were asked to check the faults which they thought appeared in the student's recording.

A tabulation was made of (A) numbers and percentages of students and instructors who marked the same faults, (B) numbers and percentages of times only the instructor marked the faults, (C) numbers and percentages of times only the students marked the faults, and (D) numbers and percentages of times of total disagreement (B and C added together).

The average percentage of agreement was 7 per cent for faults recognized; of disagreement, 19.5 per cent. A t test was applied to the two percentages to determine the significance of the difference between agreement and disagreement. The result was a t of 5.95. The difference was significant beyond the 1 per cent level of confidence.

A t test was applied to each of the fifteen faults to test difference between agreement and disagreement. In fourteen of the fifteen cases, the difference was significant (disagreement over agreement) at the 1 per cent level of confidence.

To the data accumulated from question seven, a Spearman Rho was applied. The resultant Rho was .741, which was significant at the 1 per cent level of confidence. This high correlation revealed a strong degree of agreement on the frequence of the use of certain terms to characterize voice quality.

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The above items appeared to indicate that the student's evaluation of his own recorded performance revealed no significant agreement with his instructor's evaluation. The null hypothesis cannot be rejected in this case.

Hypothesis Two: The incidence of agreement between the beginning college speech student and his instructor in analysis of vocal skill is not significantly greater for students who have previously heard recordings of their own voices than for students who have not.

The tabulation was made in terms of groups of students (A) who had not heard recordings of their voices, and (B) who had. A sample of 100 cases was randomly selected for each of the above two groups.

The incidence of agreement was determined by frequency comparisons, employing the Chi square method. Chi square tables were constructed for eleven of the fifteen vocal faults listed in question seven. On four of the faults there were no cases of agreement, and consequently a Chi Square method of evaluation could not be used.

In only one fault of the fifteen was there significant agreement between student and instructor. This one exception could not be considered justification for rejection of the hypothesis, and there was still relatively little agreement for other variables.

Hypothesis Three: The incidence of agreement between the beginning college speech student and his instructor in rating the student's speech achievement is not significantly greater for students who have previously heard recordings of their own voices than for students who have not.

The tabulation was made in terms of groups of students (A) who had not heard recordings of their voices, and (B) who had. A sample of 100 ratings was randomly selected for the two groups. Three statistical methods were used on these data:

1. Chi square was used to compare the frequencies of specific rating scores between the students who had not heard recordings of their voices and their instructors, and those who had and their instructors. The resultant Chi square was not significant at the 10 per cent level of confidence. Little difference was revealed between the rating frequencies of the two groups.

2. A Coefficient of Correlation was used as a supplement to the X^2 for each of the two groups, the agreement in ratings along the entire scale between the students and the instructors. The object was to discover if there was more student-instructor agreement in the "no previous recording" group than in the "previous recording" group, or vice-versa. Both of the correlations were so low that there appeared no justification to reject the hypothesis on the basis of what they revealed.

3. A $\underline{t}$ test was used to determine differences between the mean ratings of instructors and students on both the "previous recording" and "no previous recording" groups. The resultant $\underline{t}$'s could not be considered as a basis for rejecting the no difference hypothesis.

It seemed reasonable to assert that the incidence of agreement between student and instructor was not significantly greater for students who had previously heard recordings of their voices than for students who had not.

Hypothesis Four: The incidence of agreement between the beginning college speech student and his instructor in analysis of vocal skill is not significantly greater for students who have had previous speech training than for students who have not.

The tabulation was made as for Hypothesis Two. The significance of agreement was determined by the use of Chi square, which was computed for all but three of the fifteen vocal faults in question seven. In only one fault of the fifteen was there significant agreement between student and instructor. This one exception was not considered justification for rejecting the hypothesis.

Hypothesis Five: The incidence of agreement between the beginning college speech student and his instructor in rating the student's speech achievement is not significantly greater for students who have had previous speech training than for students who have not.

The tabulation was done for Hypothesis Three. The following statistical methods were used:

1. Chi square was used to compare the frequencies of specific rating scores between the students who had not had previous speech training and their instructors, and those who had and their instructors. The resultant Chi square was not significant at the 10 per cent level of confidence.

2. Coefficient of Correlation was used as a supplement to the X^2 to determine, for each of the two groups, the agreement in ratings along the entire scale between the students and the instructors. Both of the correlations were so low that there appeared no justification to reject the hypothesis on the basis of what they revealed.

3. A $\underline{t}$ test was used to determine the difference between the mean ratings of instructors and students on both the "previous training" and "no previous training" groups. The resultant $\underline{t}$'s could not be considered a basis for rejecting the no difference hypothesis.

It seemed reasonable to assert that the incidence of agreement between student and instructor was not significantly greater for students who have had previous speech training than for those who have not. The null hypothesis, therefore, cannot be rejected in this case.

Analysis of Data on Improvement of Speaking

A standard error of the mean difference was computed on the established panels to determine the reliability of ratings of the several panels. The data indicated that the chances were better than a hundred to one that in rating of similar stimuli none of the panels would vary in mean score by a significant amount.

Analysis of Variance was here employed to determine if any significant variability existed among the records and between the panels. The resultant $\underline{F}$'s indicated that the six judging panels showed little variability when exposed to a group of variable stimuli.

In order to determine if the judges in the panels were all judging the same thing, the data was subjected to the test of average intercorrelation of rating ($\bar{r}$). The resultant $\bar{r}$'s were sufficiently high to give strong indication that the judging panels were in relative agreement as to what they were judging.

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The sample groups were equated by the following means. All first-recording ratings were tabulated by groups, and by speech classes within the groups. Of Groups I, II, and III, the group that had the least number of average scores in each one of the nine segments of the rating scale would determine the number of records that would be used in any of the three groups in that segment. This method was carried out and the three equated groups were established.

The finally equated groups were then subjected to the test of Analysis of Variance. The resultant F's were significant beyond the 1 per cent level of confidence, indicating that not once in a thousand times would the similarity of scores in the groups probably occur by chance.

Hypothesis Six: The typical use of the voice recording as a teaching device for the beginning college speech student does not contribute to the improvement of the student's vocal skill.

In applying a statistic to the first and second ratings of the three groups of student recordings, it was necessary to bear in mind that the sets of scores were not random in respect to each other. Consequently, a t for Related or Correlated Measures was applied. The tests were to discover if any significant differences existed between the first and second recordings.

The t's for the scores from Group I, the group which was subjected to the full recording program, showed no significant difference between first and second recordings. The t's for Group II, the students who made recordings but did not hear them, were significant at the 10 per cent level of confidence. The t's for Group III, the group with no recording program at all, showed no significant difference between first and second speeches. In view of these findings, the hypothesis that the presence of a recording program does not contribute to the student's vocal skill, could not be rejected.

Hypothesis Seven: The typical use of the voice recording as a teaching device for the beginning college speech student does not contribute to the improvement of the student's speech adjustment.

The t tests were applied to the before and after ratings on the recordings of the three groups, for speech adjustment. The group employing the full recording program showed improvement, but it was nonsignificant. The group that made their records but did not hear them showed improvement at the 10 per cent level of confidence. The group which employed no recording program at all showed improvement, but it was nonsignificant. In the light of these findings, it appeared that the hypothesis that the presence of a recording program does not contribute to the student's speech adjustment, could not be rejected.

Hypothesis Eight: The typical use of the voice recording as a teaching device for the beginning college speech student does not contribute to the improvement of the student's general speech effectiveness.

The t tests were applied to the before and after ratings on the recordings of the three groups, for general speech effectiveness. The group employing the full recording program showed improvement in average ratings, but it was nonsignificant. The group that made their records but did not hear them showed improvement in average ratings, but it was nonsignificant. The group which employed no recording program at all, showed significant improvement at the 1 per cent level of confidence. In view of these conditions, it appeared that the hypothesis that the presence of a recording program does not contribute to the student's general speech effectiveness could not be rejected.

Analysis of Data on Improvement of Student Attitudes Toward the Speech Class

Hypothesis Nine: The typical use of the voice recording as a teaching device for beginning college speech students does not add to the student's interest in the class itself.

Of the groups of students that were studied for this hypothesis one of the Groups, Group I, did show greater interest in the course than the other two. It seemed a reasonable interpretation of the data that the group that showed the greatest interest in the course possessed that interest because it had been subjected to a recording program. In other words, the typical use of the voice recording as a teaching device for beginning college speech students probably does add to the student's interest in the class itself. The hypothesis was rejected.

Conclusions

In terms of the results of this study, the following conclusions were drawn:

1. There is no evidence that analysis of vocal skill by the student who reports that he has previously heard a recording or recordings of his own voice agrees more significantly with the analysis of his instructor than does that by the student who reports that he has never before heard a recording of his own voice.
2. There is no evidence that analysis of vocal skill by the student who reports that he has had previous speech training agrees more significantly with the analysis of his instructor than does that by the student who reports no previous speech training.
3. There is no evidence that analysis of speech achievement by the student who reports he has previously heard a recording or recordings of his own voice agrees more significantly with the analysis of his instructor than does that by the student who reports that he has never before heard a recording of his own voice.
4. There is no evidence that analysis of speech achievement by the student who reports that he has had previous speech training agrees more significantly with his instructor's evaluation than does analysis by the student who reports that he has not had previous speech training.
5. There is no evidence that the use of the recorder as a teaching device for beginning college speech students contributes to the improvement of the students' vocal skill.
6. There is no evidence that the use of the recorder as a teaching device for beginning college speech students contributes to the improvements of the students' speech adjustment.
7. There is no evidence that the use of the recorder

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as a teaching device for beginning college speech students contributes to the improvement of the students' general speech effectiveness.

8. It appears that the use of the recorder as a teaching device in beginning college speech classes does make some contribution to the student's interest in the class itself.

9. The majority of the students who hear recordings of their voices for the first time are not displeased, oral comments to the contrary. The greater number find their voices either reasonably good or better than they had expected.

Microfilm $2.50; Xerox $7.40. 156 pages.

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ZOOLOGY

THE DEVELOPMENT OF THE ADRENAL GLAND IN AMBLYSTOMA PUNCTATUM WITH AN ANALYSIS OF FACTORS AFFECTING THE NEURAL CREST COMPONENT

(L. C. Card No. Mic 59-5539)

Laura Gaddes Anderton, Ph.D.
The University of North Carolina, 1959

Supervisor: Dr. H. E. Lehman

A specific type of adrenal gland occurs normally in each of the vertebrate classes but cases of anomalies which resemble adrenals of another class are also found. The adrenal anomaly in man of accessory adrenal tissue has recently attracted medical interest. This type of gland abnormal in mammals, normally occurs in urodeles. The purpose of this investigation was to study factors which affect the origin and union of the widely separated adrenal components of different germ layer origin into various morphological types of adrenal glands.

Normal development of both adrenal components was studied in Amblystoma punctatum from their origin in the embryo to the 170 mm adult. Three types of experiments were performed. The trunk neural crest was extirpated bilaterally for the purpose of finding the effect on the migration, differentiation, and proliferation of each component during larval life. A second series of experiments involved the transplantation of neural crest mid-ventrally on embryos deprived of trunk neural crest. The relationship between the osmophil and fuchsinophil cells in the cortical cell population was investigated by subjecting amphibia to radical temperature changes and to ACTH injection.

In Amblystoma larvae devoid of trunk neural crest, sympathetic ganglia and adrenal medullary cells developed in late larval life but they did not replace the normal cell complement. It was demonstrated that secondary proliferation of adrenal cortical cells can take place in the absence of all but a relatively small percentage of the normal adrenal medullary component. Cells from neural crest homografts placed ventrally in trunk crest free Amblystoma larvae migrated to the region of the vena cava where they became sympathoblasts. It was found that normal pathways of migration are not essential for the development of sympathoblasts. Evidence was presented that fuchsinophil cells are a part of the secretion cycle of osmophil cells.

In the development of many organs (i.e., eye, ear) whose components originate from different germ layers, an inductive sequence involving close association of the components can be demonstrated. Evidence was presented that in the case of the adrenal glands of Amblystoma punctatum there is instead a high degree of independence between the adrenal components. It was concluded that contact between the adrenal components is not necessary for their differentiation and proliferation. The morphogenesis of normal adrenals in urodeles and of accessory adrenals in man is described in terms of intrinsic migratory powers of the neural crest, chronological determination, tissue affinities, and hormonal stimulation via the blood stream.

Microfilm $2.50; Xerox $4.00. 73 pages.

STUDIES ON THE CONTROL OF THE CLOVER ROOT BORER Hylastinus obscurus (Marsham) IN OHIO, WITH NOTES ON COINCIDENTAL CONTROL OF THE MEADOW SPITTLEBUG.

(L. C. Card No. Mic 59-5346)

Bernard Auman App, Ph.D.
The Ohio State University, 1953

The clover root borer Hylastinus obscurus (Marsham) is a pest of red clover introduced into the United States from Europe sometime prior to 1878. It was first reported in that year attacking clover in western New York and has since spread to all parts of northern United States and Canada wherever red clover is an important crop. Although principally a pest of red and mammoth clovers, it has been recorded feeding on alsike clover, crimson clover, sweet clover, alfalfa, vetch, garden peas, and field beans. The roots of clover become infested during the spring of the crop year and damage is most apparent about the time the first hay crop is harvested. The larvae tunnel within and throughout the clover roots, often killing the plant. Many infested plants are pulled out by the mower at harvesttime and others remain so weakened that they make very little regrowth. Such conditions result in a reduced second crop of hay or reduced seed yields.

The clover root borer passes the winter as an adult in the roots of old clover. In the spring they emerge and fly to new clover and deposit their eggs in the roots. Data

were obtained on the time of the adult flight in Ohio by the use of tangle foot traps. Over the three year period 1950-52 adults were trapped only during the month of May. Of the total, 68 per cent were taken from May 1 to 10. The larvae are legless and creamy-white, and have a straw-colored head capsule. Pupation occurs in the roots from July to September. The pupal period lasts from 10 to 13 days. There is but one generation of this insect each year.

The control of this pest with insecticides is difficult owing to the protected habitat of the larvae. Studies conducted in Ohio during 1947–49 showed that the borer can be controlled with dusts of some of the newer organic insecticides. The present study was made to determine the minimum effective dosages, the practical methods of application, the comparative effectiveness of sprays and dusts, the effect of adding a fungicide to the insecticide, the insecticidal residues present on the forage at harvest, and the effect of the treatments on the seed yields.[1]

1949–50 TESTS

On September 29, 1950, a series of plots arranged in a Latin square was treated with dilute dusts of BHC at 1.0 pound of the gamma isomer per acre, BHC formulated from 98 per cent gamma material at the same dosage, aldrin at 1.5 pounds, and chlordane at 3.0 pounds. The materials were applied with a hand-operated fertilizer distributor. Data on the root borer population were taken on August 3, 1950, by digging and dissecting a sample of 15 roots from each plot. Aldrin at 1.5 pounds per acre reduced the root borer population 60.8 per cent. The other materials were less effective. These tests indicated that the dosages tested would not furnish adequate control of the clover root borer.

Another series of plots was treated on May 2, 1950, with BHC at 1.00 and at 0.75 pound of the gamma isomer per acre, lindane at the same dosages, chlordane at 3.0 and 5.0 pounds, and parathion at 5.0 pounds. The plots were arranged in a randomized block replicated 5 times. Root samples from each plot were dug and dissected on August 7–8, 1950. The chlordane treatments reduced the root borer population 87.1 and 71.0 per cent. The other materials did not provide effective control, further indicating that the dosages used in 1949–50 were too low to be of value.

On May 11, 1950, sprays and dusts of BHC, aldrin, and chlordane were applied with hand equipment to small plots of red clover arranged in a Latin square. Samples of roots from these plots, examined August 8–11, showed that BHC at 1.0 pound of the gamma isomer per acre as a dust reduced the root borer population 88.6 per cent and as a spray, 75.0 per cent. Aldrin at 1.0 pound per acre as a dust caused a reduction of 56.8 per cent and as a spray, 63.6 per cent. When applied as a spray, chlordane at 5.0 pounds per acre reduced the population 83.0, and when applied as a dust, 72.7 per cent.

Two tests were made by means of equipment available on most farms to apply the materials. In one, a grain drill with the tubes removed from the shoes and allowed to hang loose was used. Very satisfactory distribution of the dust was obtained by this method. Aldrin at 0.75 pound per acre, BHC at 0.84 pound of the gamma isomer, and chlordane at 3.23 pounds reduced the root borer population 77.0, 68.4, and 63.5 per cent respectively. In the other test, a tractor drawn fertilizer distributor 10 feet wide applied the dusts very efficiently. Aldrin at 1.82 pounds per acre reduced the population 97.6 per cent, and BHC at 1.47 pounds of the gamma isomer reduced it 81.7 per cent.

None of the 1949–50 tests significantly increased the seed yields, although clover heads from some of the treated plots produced more seeds per head than heads from untreated plots.

1950–51 TESTS

On September 12, 1950, dusts of aldrin at 1.75 pounds per acre, chlordane at 4.0 pounds, BHC at 1.25 pounds of the gamma isomer, and lindane at 1.25 pounds were applied to plots of red clover arranged in a Latin square. During August 20–21, 1951, a sample of 15 roots per plot was dug and dissected. Aldrin, chlordane, BHC, and lindane reduced populations 98.1, 90.4, 71.5, and 56.1 per cent respectively.

Seed yields as determined from four areas one-fourth square yard in size harvested in each plot did not show any significant differences. However, plots treated with aldrin and showing the highest control also had the highest yield.

Plots of red clover arranged in a randomized block replicated four times were treated on May 4, 1951, with dusts of aldrin, heptachlor, and perthane. Data taken August 22 by digging and dissecting 15 roots per plot showed that heptachlor at 1.75 and 1.5 pounds reduced the root borer population 100.0 and 97.4 per cent; aldrin at 1.75 pounds 98.7 per cent, and at 1.5 pounds 91.9 per cent; and perthane at 4.0 pounds 66.5 per cent. No significant differences in seed yields as a result of the treatments were found.

To compare the effectiveness of sprays and dusts one-fourth acre plots arranged in a randomized block replicated four times were treated on May 2, 1951, with aldrin and BHC by means of power equipment. BHC at 1.9 pounds of the gamma isomer per acre applied as a dust reduced the population 89.3 per cent and as a spray at 1.8 pounds, 11.6 per cent. Aldrin at 1.9 pounds per acre as a dust reduced the population 92.8 per cent and as a spray, 94.6 per cent. No significant increases in seed yields were shown in harvesting and threshing the heads from six one-fourth square yard areas in each plot.

1951–52 TESTS

The work conducted during 1951–52 was planned to emphasize the effectiveness of sprays in root borer control. A series of plots of red clover arranged in a Latin square was treated on September 20, 1951, with emulsion sprays of heptachlor at 1.75 pounds per acre, aldrin at 1.75 pounds, BHC at 1.75 pounds of the gamma isomer, and chlordane at 4.0 pounds. None of the treatments were very effective as determined from samples of roots dug and dissected during July 28–29, 1952. Heptachlor was the most effective material and averaged a population reduction of 44.5 per cent. Aldrin caused a reduction of 32.1 per cent. BHC and chlordane were ineffective in these tests. None of the treatments had any effect on the seed yields.

Another series of plots was treated on May 1, 1952, with emulsion sprays of heptachlor at 1.5 and 1.0 pounds per acre, isodrin at 0.75 pound, and dieldrin at 0.75 pound. The plots were arranged in a Latin square. A sample of

15 roots per plot were dug and dissected during the period of July 30–August 4 to determine the effectiveness of the treatments. As in the fall tests none of the sprays effectively controlled the root borer. Heptachlor, which gave the best control, at 1.5 and at 1.0 pound per acre, reduced the number of borers only 44.1 and 40.7 per cent respectively. Differences in seed yields were not significant, but clover heads from plots sprayed with heptachlor at 1.5 and 1.0 pounds per acre averaged 32.2 and 31.4 seeds per head compared with 27.7 for heads from untreated plots.

Plots of red clover 63 x 350 feet in size, arranged in a randomized block replicated four times, were treated on May 2, 1952, by means of a power sprayer with emulsion sprays of heptachlor at 1.75 pounds, aldrin at 1.75 pounds, and BHC at 1.75 pounds of the gamma isomer per acre. Root samples dug and dissected on August 6 showed that heptachlor reduced the root borer population 60.4 per cent. The other materials were much less effective in these tests. Samples of clover heads from each plot were harvested on August 20 and threshed by hand. Heads from the plots treated with heptachlor averaged 56.9 seeds per head compared to 39.9 for heads from untreated plots.

For comparative purposes small plots of clover in the same field were treated on May 3 with dilute dusts of the same materials at the same dosages. Samples of roots dug and dissected from each plot on August 5 showed that all the dusts were more effective than sprays. Heptachlor reduced the number of root borers 99.4 per cent, aldrin 83.4 per cent, and BHC 80.9 per cent. In samples of clover heads harvested by hand and threshed to determine the number of seeds, those from plots treated with heptachlor, aldrin, and BHC averaged 38.8, 37.8, and 39.8 seeds per head compared to 23.7 for heads from untreated plots.

Two tests using a fungicide combined with insecticides were made; one was sprayed on November 9, 1951, the other on April 28, 1952. In both tests the clover plots were arranged in a Latin square. The fungicide used was compound 162 (hexachlorocyclopentadiene), a new experimental material. It was applied at 20.0 pounds per acre in combination with sprays of aldrin and heptachlor each at 1.75 pounds per acre. These insecticides without the fungicide were also included in the tests. During August 11–12, 1952, samples of roots were dug from each plot. The roots were graded on the degree of disease discoloration with a scale of 0–10. The roots were also dissected to determine the root borer population.

In the plots treated November 9, 1951, the root borer population was reduced 83.6 per cent by aldrin alone and 97.2 per cent by the aldrin combined with a fungicide. Heptachlor when used alone reduced the population 92.0 per cent and when combined with a fungicide, reduced it 77.0 per cent. All the roots from untreated plots showed disease symptoms, whereas only 84.0 to 97.3 per cent from the treated plots showed them. The degree of discoloration averaged 6.9 for untreated plots, 2.7 for aldrin plus a fungicide, 4.1 for aldrin alone, 4.3 for heptachlor plus a fungicide, and 4.1 for heptachlor alone.

Data from the plots treated April 28, 1952, showed that poorer control of the root borer was obtained than in the earlier tests. Aldrin alone reduced the number of borers 9.5 per cent and aldrin plus a fungicide 61.0 per cent. Heptachlor alone was 76.8 per cent effective and with a fungicide 73.7 per cent. The degree of disease discoloration was slightly less in the treated plots but the addition of the fungicide had little, if any, effect on the number of diseased roots.

INSECTICIDE RESIDUES

Samples of clover forage were analyzed by the Division of Insecticide Investigations, Bureau of Entomology and Plant Quarantine, in 1951 and 1952 to determine the insecticide residues present on the hay. There was considerable variation between years and among the plots. Forage harvested in June from plots treated in September with aldrin, BHC, and heptachlor averaged 0.1 – 0.36, 0.5 – 1.56, and 0.5 parts per million respectively. Forage treated in May with aldrin, BHC, and heptachlor contained residues of 5.6 – 7.2, 0.98 – 7.1, and 5.1 – 12.8 ppm., respectively, when harvested in June. More data on insecticide residues must be obtained before conclusions can be drawn or control recommendations made.

EFFECT OF ROOT BORER TREATMENTS ON THE MEADOW SPITTLEBUG

In earlier tests it was noted that many of the root borer treatments practically eliminated infestation by the meadow spittlebug Philaenus leucophthalmus (L.), another important legume pest. In order to determine whether two major clover pests could be controlled with a single treatment, data on the population of spittlebug nymphs were taken in all of the root borer experiments.

In the 1949–50 experiments aldrin and BHC applied in September, 1949, reduced the numbers of spittlebug nymphs present in May, 1952, by 90 per cent or more. Chlordane was not effective at the dosage used in this test. Dusts of aldrin, BHC, and chlordane applied in early May, 1950, for root borer control gave nearly a 100 per cent reduction in the spittlebug population.

Aldrin, BHC, and lindane applied September 12, 1950, for root borer control reduced the number of spittlebug nymphs present in May, 1951, more than 90 per cent. Chlordane in these tests was again unsatisfactory. No infestation by spittlebug numphs was found in counts made in plots treated with BHC, aldrin, heptachlor, and perthane for root borer control in May 1951, whereas 77 per cent of the stems in untreated plots were found to be infested.

Plots treated in September 1951 with sprays of aldrin, chlordane, BHC, and heptachlor for root borer control had respectively 71, 81, 89, and 91 per cent fewer spittlebug nymphs than untreated plots in May, 1952. Plots treated in May 1952 with sprays or dusts of aldrin, heptachlor, dieldrin, or isodrin reduced the spittlebug population more than 98 per cent.

CONCLUSIONS

As a result of these studies certain conclusions are apparent. It has been demonstrated that the clover root borer can be controlled by some of the organic insecticides applied either in September of the planting year or in early May of the crop year. The more promising are aldrin at 1.75 to 2.0 pounds per acre, heptachlor at 1.75 to 2.0 pounds per acre, and BHC at 1.5 to 2.0 pounds of the gamma isomer per acre.

Data obtained to date indicate that dilute dusts are

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

more effective than sprays. Although sprays have provided good control of the clover root borer in some experiments, their effects have been more variable. Additional data on sprays are needed, especially from tests using more than 5 to 6 gallons of material per acre.

It was shown in these studies that very good control of the root borer could be obtained when the dilute dusts were applied with a grain drill or with a fertilizer distributor. This would eliminate the necessity for having costly dusting equipment.

None of the materials tested significantly increased the seed yield of red clover. However, clover from some of the treated areas showed a marked tendency to produce more seeds per head than that from the untreated areas.

Considerable variation was found in the insecticide residues remaining on the forage at harvesttime as a result of these treatments. Additional data must be obtained before conclusions can be drawn.

There may be a relationship between the infestation of the clover root borer and the presence of certain root diseases. Some of the treatments showed slightly less disease where the borer was controlled, but combining a fungicide with the insecticide had no additional effect in the two tests made.

Data obtained from these experiments also show that any of the insecticides that effectively controlled the clover root borer applied either in September or May also provided excellent control of the meadow spittlebug, another important legume forage pest, in the spring.

Microfilm $2.50; Xerox $3.60. 67 pages.

1. This research was conducted at the Legume Seed Research Laboratory, Columbus, Ohio, maintained cooperatively by the United States Department of Agriculture and The Ohio State University.

Abstract published by special arrangement with The Ohio State University.

A GENETIC ANALYSIS OF THE AMERICAN JERSEY CATTLE CLUB STAR BULL PROGRAM

(L. C. Card No. Mic 59-6622)

William Jacob Brakel, Ph.D.
The Ohio State University, 1954

The Star Bull Program, initiated in 1939 by the American Jersey Cattle Club, was designed to serve as a guide in the evaluation of the pedigrees of unproved Jersey sires. Stars ranging from one to seven in number are awarded bulls on the basis of the butterfat production and body conformation of their dams plus the performance of the progeny of their parents and grandparents. Each additional star implies a higher genetic worth.

The objectives of the dissertation were (1) to evaluate the merits of this program as measured by the butterfat production and body conformation of the progeny of star bulls, and (2) to develop a selection index which could be used as a possible means of improving the effectiveness of this program.

The progeny performance of the sires in the various star groups was determined by comparing the 1,141 bulls contained in the 1944-1949 Tested Sire Reports with the 15,109 star bull certificates issued during the 6 years subsequent to January 1, 1943. The average butterfat production of the daughters of 471 sires was found to be 458 pounds on a twice-a-day milking, 305-day lactation, mature-equivalent basis, and the type classification ratings of the daughters of 280 of these sires averaged 83.6.

The regression of the daughters' mean butterfat production on their sires' star rating was 8.62 pounds with 5 per cent fiducial limits of 4.30 to 12.94 pounds. This regression was linear and significant at the 1 per cent level. No real difference was found between the average type classification scores on the progeny of the sires in the one to six star groups.

The data used in this evaluation may have contained bias from a number of sources. It is possible that bias in a manner favorable to the Star Bull Program resulted from (1) genetic differences between sires' mates and (2) environmental differences to which the sires' progeny were subjected. Another source of bias which would likely be unfavorable to the program was the marked difference between the star bull groups in the percentage of bulls to become Tested Sires.

The multiple correlation method was used to construct a selection index which indicated the relative importance of the eleven pedigree variables used in the Star Bull Program. The two traits included in this index were butterfat yield and type classification ratings. Numbers 6 to 1 were assigned to the type ratings Excellent to Poor, respectively. The relative economic value of type was considered to be one-third that of butterfat production. The 55 simple correlations between the eleven pedigree variables were computed from information on 173 star bull certificates. Each pedigree, used for this purpose, was complete for these eleven variables. Other statistics used in the construction of this index were the heritability, the correlation between paternal and maternal sisters, the phenotypic variance, and the genetic correlation of the two traits. These constants had been determined previously using Jersey data and were not computed in the dissertation. A path coefficient diagram was used to illustrate the relationship between the pedigree variables and the sire's aggregate breeding value. The equation for the selection index was found to be:

$$I = .163\overline{B}_{SO} - 2.348\overline{T}_{SO} + .095B_D + 2.268T_D - .007\overline{B}_{DO} + .079\overline{B}_{PSO} + 2.701\overline{T}_{PSO} - .057\overline{B}_{PDO} - .011\overline{B}_{MSO} + 9.247\overline{T}_{MSO} - .054\overline{B}_{MDO}$$

In this partial regression equation the symbols refer to the pedigree variables and are explained as follows:

S = Sire of bull being indexed
D = Dam of bull being indexed
PS = Paternal grandsire
PD = Paternal grandam
MS = Maternal grandsire
MD = Maternal grandam
O = Progeny
B = Butterfat yield
$\overline{B}$ = Mean butterfat yield
T = Type classification rating
$\overline{T}$ = Mean type classification raging

The multiple correlation between the selection index constructed in the dissertation and the sire's genotype for type and production was found to be .354, the loss in

accuracy being caused by environmental and nonadditive genic effects on the pedigree variables.

In addition to a distinct change in the emphasis given certain ancestors and relatives, the use of this index would eliminate the present ceiling above which no superiority in performance is recognized. Suggestions were made regarding the adaptation of the selection index to the allocation of credits in the American Jersey Cattle Club Star Bull program.

Microfilm $2.50; Xerox $3.80. 67 pages.

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OBSERVATIONS ON THE ECOLOGY OF PROTOZOA ASSOCIATED WITH SPHAGNUM

(L. C. Card No. Mic 59-6627)

Peter Chacharonis, Ph.D.
The Ohio State University, 1954

The unusual protozoan fauna characteristic of sphagnum bogs has been known for many years, but very few investigators have studied the actual relationships that exist between various Protozoa and the sphagnum plant itself. None have done so systematically and intensively. This has been attempted in the present study of Protozoa associated with sphagnum in an acid bog on Cranberry Island at Buckeye Lake in central Ohio. An entirely new type of ecological relationship has been observed. The Protozoa live not only in small pools on the bog, or in water around the base of the plant, but also in a variety of locations on and in the sphagnum plant itself.

Cranberry Island is a cranberry-sphagnum bog and is of particular interest because its dominant vegetation is composed of boreal species, which are relicts of early postglacial times. It is similar to bogs of more northern regions, and developed at this relatively low latitude during the Cary substage of the late Wisconsin epoch.

Because of its structure, its mode of growth, and the conditions under which it lives, sphagnum affords an excellent habitat in which various species of Protozoa can live. The sphagnum plant continues to grow at its apex while it dies beneath. Thus there is a continuous development of new shoots above the accumulation of dead sphagnum. The elongate hyaline cells (cell spaces) of the stem and branches and the hyaline cells of the leaves offer a system of reservoirs and capillaries through which water is readily conducted. Upward movement of water is also aided by the hanging leaves and branches which are closely appressed to the stem. These leaves and branches form an absorbing and water-conducting mantle. As a result of these relationships the entire surface of the sphagnum plant is almost continuously covered with at least a thin film of water. This affords an ideal habitat for certain microscopic organisms.

During the investigation 24 collections were made, from April, 1953, to August, 1954. Eight collecting stations, representing three different species of sphagnum, were visited on each trip. The species were Sphagnum palustre Linn. at five stations, Sphagnum capillaceum (Weiss) Schrank at two, and Sphagnum recurvum Beauv. at one. With the exception of that from Sphagnum recurvum, the faunas from the various stations were rather similar qualitatively, and differed from station to station chiefly in the frequency of individual species.

To study the distribution of the Protozoa on the individual sphagnum plant, the latter was cut into four sections, bottom, middle, upper, and apex, and observations were made on the numbers and position of all the species present on these several parts of the plant.

At all stations except the one with Sphagnum recurvum, practically all the hyaline cell spaces of the sphagnum leaf at the higher levels are inhabited by Carteria sp., Chlorogonium sp., Notosolenus sp., Euglena mutabilis, green ciliates I and II, and a small roundworm. Some of these are also numerous on the surfaces of stems and leaves. Larger organisms, such as testacean rhizopods, rotifers, and water mites, likewise live on these outer surfaces, especially within the tiny water pockets formed between the imbricated leaves.

The various species found may be divided into two main associations, according to their position on the sphagnum plant. Those characteristic of the more highly illuminated upper portion of the plant have been termed photophilic; most of these either possess chlorophyll or possess green zoöchlorellae. Those characteristic of the relatively darker, lower portion of the plant were termed nonphotophilic; all of these are without chlorophyll or zoöchlorellae.

The general micropopulation of the bog persists throughout the entire year and exhibits an unusual tolerance to low temperatures. Certain forms reach their maximum growth at particular seasons of the year, presenting what might be termed a seasonal dominance.

There is evidence that there is an extremely low concentration of dissolved oxygen at the bottom of the sphagnum plant and in the decomposing muck underneath. The species here must therefore live under nearly anaerobic conditions.

Amount of moisture is a decisive factor in the distribution of Testacea at the different stations on the bog.

A food relationship was observed between the holophytic and holozoic species. Many of the Testacea were seen with food vacuoles containing Carteria sp., and Chlorogonium sp.

Along the length of the sphagnum plant there was a definite correlation between the number of bacteria and the number of small phagotrophic and saprozoic Protozoa. Much larger numbers of these were found at the bottom level.

The changes brought about by the continuous growth of the sphagnum at the top and decomposition at the bottom bring about a continuous migration of microörganisms upward and a succession of species at any given level.

Twenty species of Sarcodina, ten species of Mastigophora, and six species of Ciliophora were recorded from the water impounded on and in the sphagnum plant. They were:

Mastigophora
- Carteria sp.
- Chlorogonium sp.
- Notosolenus sp.
- Euglena mutabilis Schmitz
- Carteria klebsii (Dangeard) Francé
- Cryptomonas ovata Ehrenberg

Mastigophora (continued)
Menoidium incurvum (Fresenius) Klebs
Distigma gracilis Pringsheim
Chilomonas paramecium Ehrenberg
Trichloris sp.

Sarcodina
Heleopera picta Leidy
Hyalosphenia papilio Leidy
Hyalosphenia elegans Leidy
Nebela collaris (Ehrenberg) Leidy
Sphenoderia lenta Schlumberger
Euglypha ciliata (Ehrenberg) Leidy
Arcella vulgaris Ehrenberg
Euglypha alveolata Dujardin
Nebela dentistoma Penard
Assulina seminulum Ehrenberg
Heleopera petricola Leidy
Centropyxis sp.
Cyphoderia sp.
Difflugia lobostoma Leidy
Nebela flabellulum Leidy
Trinema enchelys (Ehrenberg) Leidy
Acanthocystis sp.
Actinophrys sol Ehrenberg
Amoeba guttula Dujardin
Amoeba sp.

Ciliophora
Green ciliate I
Green ciliate II
Trichopelma sp.
Opisthotricha sphagni Kahl
Colpoda sp.
Vorticella sp.

Microfilm $2.50; Xerox $4.20. 79 pages.

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CHEMICALLY INDUCED TUMORS IN CHICKENS

(L. C. Card No. Mic 59-5448)

Charles Gangloff Crispens, Jr., Ph.D.
State College of Washington, 1959

Supervisor: Dr. Herbert L. Eastlick

In this study, 121 chickens (30 two-week old White Silkie bantam chicks, 24 juvenile White Silkie bantams and 67 two-week old White Leghorn chicks) received intraperitoneal injections of methylcholanthrene, a method not previously reported in the literature. Each bird was given three inoculations, with a three-week interval between each, of 0.10 cc. of methylcholanthrene (3.0 per cent and 4.0 per cent suspensions) in carrier (sesame oil or sesame oil - Tween 80). Tumors were observed in 39 chickens (11 White Silkie bantams and 28 White Leghorns) during the interval 18 to 66 weeks after treatment. Leukosis was observed in 25 per cent of the controls (compared to a 20.7 per cent incidence in experimental birds), but other tumors were not seen.

The influence of both extrinsic factors (route, solvent and dosage) and intrinsic factors (sex, age and strain variation) on tumor induction in the chemically treated chickens was considered. A significant difference in tumor incidence was indicated between the two strains tested.

Of the 11 tumors found in White Silkie bantams, two were fibrosarcomas and nine were lymphosarcomas. Although spontaneous malignant lymphoid tumors are quite common in the chicken, few chemically induced lymphosarcomas have been reported.

A liposarcoma, a malignant granulosa-cell carcinoma, a myxosarcoma, a lymphosarcoma, eight histiocytic sarcomas and 16 fibrosarcomas were observed in the White Leghorn chickens. These tumors are discussed in terms of their frequency, histogenesis and classification. It appears that the liposarcoma and malignant granulosa-cell carcinoma represent additions to the list of chemically induced tumors in chickens. Both the cell type of the histiocytic sarcoma and the relationship of this tumor to the fibrosarcoma are considered in some detail. It is suggested that the type cell is the macrophage (histiocyte) and that these neoplasms constitute two closely related tumor types.

An attempt was made to transplant 15 of the 39 tumors observed in this study. Of these, five were established in serial passage and one was transplantable at least once. Results are not yet available for the liposarcoma, the malignant granulosa-cell carcinoma and a fibrosarcoma.

There was no incidation of a seasonal effect, although both route and strain of host appeared to influence the transmissibility of these tumors. The proportion of chicks which developed neoplasms was observed to decrease in relation to the age of the birds when treated. Statistical treatment of these data indicated a significant difference in tumor incidence among the six age groups tested.

Supernatant fluids were prepared from neoplastic tissue obtained at various passages of one of the histiobytic sarcomas and injected into 47 chicks. Nine of these hosts developed neoplasms, suggesting the role of a virus in this apparently chemically induced avian sarcoma. Factors which both limit and support these data are considered and suggestions are made for future experimentation.

Microfilm $2.50; Xerox $5.60. 115 pages.

ISOLATING MECHANISMS IN THREE SYMPATRIC SPECIES OF TREE FROGS, GENUS HYLA, IN THE CANAL ZONE.

(L. C. Card No. Mic 59-6706)

Martin John Fouquette, Jr., Ph.D.
The University of Texas, 1959

Supervisor: W. Frank Blair

Three small species of tree frogs, Hyla ebraccata Cope, H. microcephala Cope, and H. phlebodes Stejneger are shown to be closely related, based on similarities in adult and larval morphology, call structure, and to some extent, interfertility. It is concluded that they are probably best considered as members of the Hyla loquax species-group, with ebraccata being more distantly related

than the other two. In the Canal Zone these three species are sympatric, and all call and breed in the same habitat and at the same time, often intermixed throughout the grass in a small swamp or other suitable habitat. The three populations retain their identities as discrete species, and no hybrids were identified among the hundreds of frogs seen, although two of these species, microcephala and phlebodes, were found to produce apparently viable hybrids in the laboratory.

It is concluded that the primary mechanism isolating these species is the difference in mating call, with the female apparently discriminating in favor of the call of her own species and locating the male by seeking the sound. Other courtship mechanisms such as rejection of a foreign male by the female and subsequent dislodging may also be important.

Anti-mating mechanisms, which act to prevent the physical contact of the two forms may be important in supporting isolation. Somewhat inconsistent habitat differences were noted, including a possible difference in breeding peaks, and, between microcephala and phlebodes, a possible difference in response to rainfall.

With respect to post-mating isolation, crosses involving H. ebraccata as one of the parents failed of fertilization or resulted in inviable offspring. H. microcephala and H. phlebodes were found to be substantially interfertile, which would make it apparent that the role of ethological isolation, supported by anti-mating mechanisms, is quite important in maintaining species distinctness.

Microfilm $2.50; Xerox $7.00. 148 pages.

SOME ASPECTS OF THE ECOLOGY OF SOIL ARACHNIDS

(L. C. Card No. Mic 59-6480)

Edgar Carl Gasdorf, Ph.D.
Purdue University, 1959

Major Professor: Clarence J. Goodnight

This study was concerned with three aspects of the ecology of soil arachnids. One aspect was the population variations throughout the year and possible explanations for the fluctuations. Another part of the problem was a comparison of the population in an oak-hickory forest and a flood plain forest. The third aspect was the significance of oribatid mites in the decomposition of plant debris on forest floor.

The two population investigations were studied simultaneously by collecting 484 cm^2 and 2500 cm^2 samples every two weeks for 16 months. The 484 cm^2 samples were placed in berlese funnels and the soil organisms extracted. The 2500 cm^2 samples were handsorted. Measurements of the soil moisture and soil temperature were taken at the same time.

To investigate the significance of mites in the decomposition of plant debris, proximate analyses were made on newly fallen oak leaves, leaf mold, and mite feces. This method of analysis provided some idea of the degree of decomposition of the food of the mites and also of the feces of the mites. Thus some idea of the contribution of oribatid mites to the decomposition of plant debris could be made.

The populations of all the soil arachnids fluctuated widely during the year. Concerning the mites, two peaks in the population curve could be discerned in the climax forest. One occurred in the spring and the other in the autumn. In the flood plain forest only one peak occurred in the spring. Spiders exhibited two low points, one in early spring and one in winter in the climax. In the flood plain spiders showed only one peak, which occurred in early spring. In the climax pseudoscorpions exhibited only one peak in the year which occurred in June - July. In the flood plain these animals showed one peak in the spring.

A suggested explanation for the oribatid mite population curve was based more upon their life history and biology rather than on the influence of soil temperature and soil moisture.

The climax supported a much greater population of arachnids than the flood plain. A possible explanation for this difference in population between the climax and flood plain was that the climax was not subjected to periodic flooding as the flood plain is and therefore can accumulate a thick covering of plant debris which serves as food and protection for the arachnids.

Oribatid mites were separated into presumed species and numbered. The other mites were divided into Mesostigmata and Trombidiformes. The spiders were divided into families and the pseudoscorpions were not sorted.

Results of the proximate analyses indicated that the oribatid mites investigated contributed to the decomposition of plant litter by utilizing cellulose and increasing the amount of lignin.

Microfilm $2.50; Xerox $6.60. 137 pages.

CYTOLOGICAL STUDIES IN THE LITTORALIS-MONTANA COMPLEX OF THE VIRILIS SPECIES GROUP OF THE GENUS DROSOPHILA

(L. C. Card No. Mic 59-6710)

William Charles Guest, Ph.D.
The University of Texas, 1959

Supervisor: Wilson S. Stone

Strains of Drosophila montana from three widely separated localities in Alaska and Canada and strains of Drosophila ezoana from Japan were analyzed cytologically.

The four strains of montana, collected from areas far north of the previous collection sites of this species, have 17 independent inversions superimposed on the basic gene sequences of montana. All of the inversions are present in the heterozygous condition. Seven of the rearrangements have not been reported from montana strains collected from other localities. The strains are similar to the giant forms of montana in that eight of the 17 rearrangements are in the fourth chromosome. Each of the four strains has about the same number of heterozygous inversions present as do the individual strains of giant montana although unique rearrangements appear in each strain.

The strains of montana can be divided into three types; 1) the populations which retain the basic montana gene

sequences or differ from basic montana by only one or two rearrangements, 2) the giant forms of montana which have superimposed upon the basic montana arrangements a large number of heterozygous inversions, and 3) the Alaskan and Canadian forms which have the same degree of chromosomal polymorphism as is found in giant montana but lack the larger size. Giant montana is considered to be a race or subspecies of montana and the cytological and genetic evidence indicates that the Alaskan and Canadian strains should be regarded as differing from montana to about the same extent.

Drosophila ezoana, a recently described species of the virilis group found in the northern part of the island of Hokkaido, Japan, is analyzed cytologically and the gene arrangements are compared with those present in other species of the group. This species possess a heterozygous second chromosome rearrangement, 2 F, which is similar to one present in montana. Therefore, this rearrangement should be added to the gene arrangement of Primitive III which has been proposed as the form ancestral to the montana and littoralis subgroups.

Drosophila ezoana is chromosomally primitive differing from the ancestral Primitive III by one inversion in the fifth chromosome and by a change in the structure of the Y chromosome from a rod to a J, presumably by a pericentric inversion. The species is genetically advanced in terms of isolating mechanisms. Cross fertility tests with other members of the virilis group show that insemination is rare except with virilis females. D. virilis females were inseminated when mated to ezoana but no progeny was obtained indicating that isolating mechanisms other than failure to mate are involved. D. virilis and ezoana are sympatric on Hokkaido and it is suggested that in developing reproductive isolation against virilis, cytologically and genetically the most primitive of the group, ezoana has become genetically isolated from the rest of the group.

The chromosome phylogeny of the virilis group has been modified to make Primitive III heterozygous for the second chromosome inversion 2 F, common to ezoana and montana, and to include ezoana as intermediate between Primitive III and littoralis. D. ezoana has one inversion in common with littoralis as well as a similar Y chromosome but lacks the 3-4 fusion of this species. The retention of the same heterozygous inversions in several species is pointed out. The second chromosome inversion, which must have been present in Primitive III, remained heterozygous in ezoana but was lost in the origin of littoralis. The inversion was fixed in the other line to montana and its derivatives. This resembles inversion 4 H which is heterozygous in montana and D. lacicola but fixed in D. borealis and D. flavomontana.

Microfilm $2.50; Xerox $4.20. 79 pages.

INSECTS ASSOCIATED WITH SWEETPOTATO FOLIAGE AND THEIR RELATION TO THE DISSEMINATION OF INTERNAL CORK VIRUS

(L. C. Card No. Mic 59-6562)

Dale Herbert Habeck, Ph.D.
North Carolina State College, 1959

Supervisor: Charles Henry Brett

A large number of insect species were found associated with sweetpotato foliage, many of them vectors or related to vectors of other plant viruses. Of the twenty-six genera and at least thirty-five species of leafhoppers collected, Empoasca spp. especially abrupta and bifurcata were most abundant. Leafhopper populations increased throughout the season until about the first week in October. Four species of aphids were collected from sweetpotatoes, with Myzus persicae, the most abundant species. Alate forms were found in sweetpotatoes until about mid-July, while apterous forms were collected in small numbers throughout the season except in plots dusted with insecticides. Coleoptera, Diptera, and Hemiptera were present throughout the growing season.

More than 6200 insects were employed in vector experiments but the results were inconclusive.

Natural dissemination of internal cork virus appears to be inversely related to the distance from the infected crop. Considerable variation in the magnitude of virus spread was noted from year to year. Dissemination occurred to sweetpotatoes located at least 600 yards from an infected crop, indicating that the minimum distance must be in excess of 1800 feet from infected sweetpotatoes to keep the disease from virus-free plants. In a single experiment at Clayton, N. C., internal cork virus appeared to be transmitted during early and mid-July.

Insecticides were ineffective in reducing the spread of internal cork virus either between infected and virus-free plants or within a planting containing a few infected plants.

Microfilm $2.50; Xerox $3.60. 63 pages.

THE PHOSPHORUS BUDGET OF A MUSSEL POPULATION AND ITS EFFECT ON A SALT MARSH ECOSYSTEM

(L. C. Card No. Mic 59-5684)

Edward Julian Kuenzler, Ph.D.
University of Georgia, 1959

Supervisor: Dr. E. P. Odum

The rate at which phosphorus flows through the Modiolus demissus Dillwyn population and the effect of this phosphorus pathway upon the salt marsh ecosystem were studied at Sapelo Island, Georgia.

The population density and distribution were measured by taking random samples in the marsh. The frequency distribution of weight classes was determined for the natural population. Analyses of phosphorus content of the mussels were performed bimonthly and showed significant seasonal differences, the maximum concentration of phosphorus being present just prior to spawning and the minimum just after spawning.

Mussels in small flower pots were placed in the marsh and visited bimonthly to determine growth and mortality rates. The growth rate was estimated from the increase in shell size of these mussels and the bimonthly changes in the height-to-weight ratio of the natural population. The mortality rate was obtained from the number of mussels which died in the pots. The recruitment rate was estimated from the number of small mussels which attacked naturally in the flower pots. With the above data it was possible to estimate the amount of phosphorus present in the natural population and the phosphorus flux rates into and out of the population due to recruitment, growth, mortality, and gamete formation.

Determinations were made of the amount of phosphorus present as particulate matter, phosphate ions, and dissolved organic matter in the natural marsh waters. Radioactive phosphorus was used to measure the rate at which Modiolus is capable of removing particulate matter and phosphate ions from sea water. The amount of phosphorus available to the mussel population was then calculated.

The rates of elimination of phosphorus in feces and in soluble forms, both inorganic and organic, were measured.

The turnover time of phosphorus in the population was calculated to be 100 days. The mussels, however, were capable of removing daily about one-third of the particulate matter present in the natural marsh water.

It was concluded that the major effect of the mussels upon the phosphorus budget of the salt marsh is the rapid removal of particulate matter from the water and the deposition of most of this material, in the form of pseudofeces and feces, onto the surface of the marsh mud where it may then be utilized by the abundant deposit-feeders.

Microfilm $2.50; Xerox $5.40. 106 pages.

A BIO-ASSAY AND HISTOCHEMICAL STUDY OF ANTIDIURETIC HORMONE IN NORMAL AND ADRENALECTOMIZED RATS

(L. C. Card No. Mic 59-6166)

Jean Kautz Lauber, Ph.D.
The University of New Mexico, 1959

Chairman: Professor Wilburn John Eversole

The present study is concerned with some aspects of the relationship between the hypothalamico-neurohypophyseal system and the adrenal cortex in control of body water balance. Bio-assays of antidiuretic hormone (ADH) in the blood plasma were correlated with densitometric determinations of the amount of neurosecretory material in stained sections of the neurohypophysis.

An assay based on excretion of administered water by rats was not entirely satisfactory in our hands; some possible reasons for this are discussed. One new condition, estrous state of the female, was added to the list of agents and situations that inhibit diuresis.

An assay procedure utilizing American toads was employed to determine plasma ADH levels in normal and adrenalectomized rats. The hormone titer dropped slightly below normal one day after adrenalectomy, rose to its maximum on day seven, dropped to near normal by day ten, and to subnormal levels by day thirteen.

Pituitaries from one series of rats were stained with Gomori's chrome-alum hematoxylin. In a second series, a newer histochemical technique, the performic acid-Alcian blue method of Adams and Sloper, was employed. Photoelectric determinations of density of the stained sections revealed that pituitary ADH levels rose from day one to peak levels at six to seven days. A sharp drop took place within the next two days, followed by a return toward normal levels.

Post-adrenalectomy changes in blood and pituitary ADH are compared, and the significance of these findings in relationship to the results of others is discussed.

Microfilm $2.50; Xerox $5.40. 106 pages.

HAEMOFLAGELLATES AND INTESTINAL FLAGELLATES FROM ANURA OF LOUISIANA

(L. C. Card No. Mic 59-5522)

Felix Hartwig Lauter, Ph.D.
Louisiana State University, 1959

Supervisor: Dr. Harry J. Bennett

This study was undertaken to attempt to add to the knowledge of the almost unknown haemoflagellates and intestinal flagellates in Louisiana Anura.

A total of 503 frogs and toads, representing 21 species, was collected and examined from 1953 to 1958.

The hosts were collected from 30 different localities throughout the state. However, the largest number was collected in the vicinity of Baton Rouge and adjacent areas.

Sixteen species of flagellates have been identified and studied. One of these has been described as a new species.

The haemoflagellates were stained with Giemsa. The intestinal flagellates were stained and impregnated with iron-haematoxylin and silver-protein.

The sixteen species of flagellates are as follows: Trypanosoma karyozeukton, Trypanosoma rotatorium, Retortamonas dobelli, Chilomastix caulleryi, Karotomorpha swezyi, Monocercomonoides elegans n.sp., Monocercomonoides melolonthae, Monocercomonas batrachorum, Tritrichomonas augusta, Tritrichomonas batrachorum, Trepomonas agilis, Urophagus intestinalis (?), Hexamitus intestinalis, Octomastix batrachorum, Octomitus neglecta, Trimitus parvus.

New information is presented on the biology of these flagellates in regard to their morphology, taxonomy, ecology and distribution.

A section is given to the discussion of host-parasite relationships. In addition, a check list of the haemoflagellates and intestinal flagellates is presented with the number of species of frogs and toads infected by each parasite. Microfilm $2.50; Xerox $8.60. 186 pages.

REACTIONS OF THE HONEY BEE, APIS MELLIFERA LINN., TO ITS NATURAL SOUNDS AND TO ARTIFICIAL SOUND AND VIBRATION OF KNOWN FREQUENCIES.

(L. C. Card No. Mic 59-5116)

Harold Franklin Little, Ph.D.
The Pennsylvania State University, 1959

The problem as originally conceived was to investigate the importance of sound to the honey bee, particularly with regard to the possibility of communication by means of sound. The emphasis of the research was later shifted to a study of reactions of bees to pure tones.

Tape recordings of bee sounds were made with magnetic tape recorders. Recorded sounds and pure tones were directed toward the bees with the speakers of the tape recorders and with a large public address type loud-speaker. For a source of vibration for tarsal stimulation of bees a loud-speaker was modified to make the oscillations of its voice coil accessible in the form of vibrations of a small metal disc. Bees used in the tests were of the Italian race of Apis mellifera and were worker bees except for brief tests of queens.

Tape recorded sounds of stinging bees and foraging bees were tested, but demonstration of their value as means of communication was not successful.

Stopping-reactions to sounds of pure tone were found to be easily elicited and observed. The reaction was most complete for frequencies from 500 to 1000 c.p.s. No reaction was observed below 100 or above 2500 c.p.s. Tests with surfaces vibrated by intense sound and directly by the voice coil of a loud-speaker indicated that the stopping-reaction was a result of substrate vibration.

Intact bees were exposed to vibrations while free to walk about in small plastic cages. To vibrations of about 300 c.p.s. to about 1400 c.p.s. the bees responded quite readily. Below 300 c.p.s. and above 1400 c.p.s. fewer responses occurred. No responses occurred below 130-180 c.p.s. or above 4500-6000 c.p.s. Caged queens had the same general frequency limits and intensity thresholds as worker bees.

The frequency range over which individual mounted bees would respond to tarsal vibrations was found to be from about 100 c.p.s. to about 1600 c.p.s. The threshold magnitude of tarsal vibrations was estimated as being about .05 micron. Tests indicated that the antennae are not involved in receiving the stimuli in the stopping-reaction, but that all three pairs of legs are involved and to a similar extent.

Microfilm $2.50; Xerox $3.00. 58 pages.

VOCAL VARIATION IN PSEUDACRIS CLARKI AND PSEUDACRIS NIGRITA IN TEXAS

(L. C. Card No. Mic 59-6720)

Ted Corneille Michaud, Ph.D.
The University of Texas, 1959

Supervisor: Dr. W. Frank Blair

Analysis of the call characteristics of 138 Pseudacris clarki and 75 Pseudacris nigrita, obtained from spectrographic tracings, reveals neither character displacement not introgressive hybridization when the allopatric and sympatric components of each are compared.

Tape recordings were made in pure populations of both species as well as in their zone of overlap in eastern Texas. Mean values for call duration, trill rate, interval between calls, dominant frequency, and trills per call were plotted against water temperature. Duration and interval are inversely proportional; trill rate is directly proportional. Dominant frequency and trills per call correlate very little with water temperature. Although duration, trill rate, and interval between calls are quite distinct in the two species, there is a considerable overlap in dominant frequency and in trills per call. The greatest deviations from predicted measurements were obtained at the lowest recording temperatures.

Within a size range of 8 mm. there was no observable effect of body size on call characteristics. Only a very few individuals demonstrated departures from normal calls. These suggested behavioral variation, but the causative factors remain obscure. Analysis of the effect of numbers of individuals present in a calling group yielded negative results.

Laboratory experiments were conducted to determine the reactions of females to the calls of both species presented simultaneously. The clarki and nigrita females readily resolved the calls of their own species only if they were captured in amplexus. When presented a choice between calls of their own species and that of a presumed clarki-nigrita hybrid, the discriminatory ability of nigrita females was lost. It appears that male hybrids between these species are not at a mating disadvantage because of the intermediate nature of their call.

Only one natural hybrid was found, in spite of interfertility between the species in the laboratory. It is concluded that the distinctive character of the calls is a major premating isolation mechanism separating clarki and nigrita in mixed populations.

Microfilm $2.50; Xerox $6.00. 122 pages.

EPIDEMIOLOGY OF BEAN MOSAIC DISEASES IN SOUTH CENTRAL WASHINGTON

(L. C. Card No. Mic 59-6418)

Richard S. Robertson, Jr., Ph.D.
State College of Washington, 1959

Supervisor: Dr. E. C. Klostermeyer

Studies in the epidemiology of bean mosaic diseases in south central Washington were made from 1955 through 1959.

Surveys were made of aphid populations and mosaic disease symptoms in plots of field beans at the Irrigation Experiment Station, Prosser, Washington, during the summers of 1955 through 1958. There was generally no colonization of the bean plants by aphids, but large populations of alates were present in the bean fields from late June until sometime in August. The majority of aphids were green peach aphids, Myzus persicae (Sulzer), with the bulk of the remainder consisting of pea aphids, Macrosiphum pisi (Kaltenbach), and English grain aphids,

Macrosiphum granarium (Kirby). Small numbers of several other aphid species were present from time to time. Populations of other possible arthropod vectors were few. Mosaic symptoms began appearing in the bean plots in early July and were well distributed by early August. Detailed studies of symptom development were made.

Sweetclover, red clover, and Ladino clover plants growing at the Irrigation Experiment Station were infected with virus diseases which were systemically infectious to and produced mosaic symptoms in beans. These clovers and sweetclover constitute possible overwintering reservoirs for bean mosaic viruses.

A number of different yellow mosaic virus entities were isolated from plants growing at or near the Irrigation Experiment Station; these viruses were subjected to greenhouse tests at the Main Experiment Station, Pullman, Washington. One such virus ("A" virus) induces veinal necrosis and severe mottle or top necrosis in many bean varieties, and mottle in red clover, sweetclover, and broadbean; it was transmissible readily by the green peach aphid and the clover aphid, Aphis bakeri Cowen, and with difficulty by the pea aphid; it was occasionally transmitted as the same or a milder virus through Early Pink seeds. Two other viruses ("B" and "C" viruses) induce mottle in susceptible bean varieties, sweetclover, and broadbean, and were transmissible by the same three aphid species in the same degree; sometimes a milder-seeming virus was seed-transmitted from plants infected with either of these two viruses. The English grain aphid did not transmit any of these three viruses in greenhouse tests. A fourth virus ("D" virus) induces a moderate mottling and leaf rolling in susceptible bean varieties; it also produces a mottle in broadbean, but having been passed through broadbean it induces a different, milder mottle in susceptible beans. "D" virus was transmissible readily by the green peach aphid and the clover aphid, and was seed-transmitted in a large proportion of Columbia Pinto seeds.

A common mosaic-type virus isolated from field beans at the Irrigation Experiment Station was transmissible by the green peach aphid and the clover aphid but not by the pea aphid.

Therefore, it was determined that bean mosaic viruses were being spread by aphids, especially green peach aphids, breeding outside the field; and that early-season virus inoculum was probably being provided by other legumes and bean seed-transmitted virus.

Microfilm $2.50; Xerox $5.60. 113 pages.

THE ROLE OF TWO INVERTEBRATE POPULATIONS, LITTORINA IRRORATA AND ORCHELIMUM FIDICINIUM, IN THE ENERGY FLOW OF A SALT MARSH ECOSYSTEM.

(L. C. Card No. Mic 59-5687)

Alfred Evans Smalley, Ph.D.
University of Georgia, 1959

Supervisor: Eugene P. Odum

Energy relationships of three components of a salt marsh on the Georgia coast were studied: (1) Spartina alterniflora, the only higher plant occurring on the marsh, (2) Littorina irrorata, a snail and (3) Orchelimum fidicinium, a grasshopper. Net production of Spartina was determined by periodic harvesting of the grass and calculation of the between-sample increase. Animal production was found by periodic harvesting and calculation of population biomass accumulation and biomass lost through mortality. Caloric equivalents of the three components were determined by combustion in a bomb calorimeter. Respiratory rates of the two animal species were determined over the size range of the animals and the temperature range which occurred in the marsh; total respiration of the population, as found by sampling in the marsh, was then found on an annual basis. The respiratory rates were converted to calories by Ivlev's oxycaloric coefficient, or a modification thereof. Ingestion in grasshoppers was determined by weighing feces under controlled conditions and then adding respiration and production. Ingestion for Littorina was found with the aid of a production/defecation ratio for Littorina obtained from the literature. From these data, production, assimilation and ingestion of the animals and net production of Spartina were compared on an annual basis. Production and assimilation (which is equivalent to energy flow) follow a similar pattern in both snails and grasshoppers, but population density is a very poor indication of the actual biomass or energy flow of the populations. The snails were found to be present in two distinct population segments; a large-snail population of low mortality and constant size, and a small-snail population of high mortality and constantly changing size due to variable recruitment and growth. The biomass of the large snails was so much greater than that of the small snails that, in spite of the greater respiratory rate per unit weight of the small snails, their net environmental significance was minor compared with the large snails. The annual cycle of energy flow of the grasshoppers corresponded well with their only food source, Spartina, being high in the early summer and dwindling to zero by September. The energy flow of the snails was more constant, showing only a slight mid-summer peak caused by higher summer respiratory rates. The more constant rate of the snail's energy flow was in good agreement with the constant supply of detritus in the marsh and surrounding waters, from which the snails derive their food. Utilization efficiency of Orchelimum (ingestion/net production of Spartina) was about 2%, indicating that the grasshoppers were in an environment which contained an abundant food supply. Assimilation/ingestion (based on populations over a year) was 36% for Orchelimum and 45% for Littorina; production/assimilation was 37% for Orchelimum and 14% for Littorina. It is suggested that the grasshoppers sacrifice efficiency of food concentration for a higher production rate, while Littorina, living in a food-poor environment, must expend a relatively large amount of effort in food-getting, assimilate food efficiently, and consequently have a low production rate.

Microfilm $2.50; Xerox $6.40. 135 pages.

A STUDY OF SOME ACOUSTIC FACTORS INVOLVED IN THE REPRODUCTIVE BEHAVIOR OF PSEUDACRIS

(L. C. Card No. Mic 59-5689)

Eric Fontelle Thompson, Jr., Ph.D.
University of Georgia, 1959

Supervisor: Bernard S. Martof

Analyses of field recordings of the mating call of Pseudacris triseriata feriarum indicated a high degree of relationship between the number of notes per second and water temperature. Some other characteristics, however, show little or no relationship to water temperature; these relationships are probably modified or obscured by other factors such as individual variation, stage of the breeding season, or micro-environment. A relatively simple mechanism for call production and an explanation of the way in which temperature affects the call are proposed.

In laboratory experiments, females were given a choice of two calls which differed in only one characteristic. Of 104 females exposed to natural and artificial sound stimuli, 75 reacted. The results of such tests indicated that the number, spacing, and even the occurrence of notes in a call are not necessary to elicit mating behavior of females. Females responded to a wide range of frequencies having an optimum near 1800 cps. The most effective interval between calls was about 1.25 second. The natural patterns of frequencies and intensities were not essential. Within limits, sound intensity had little or no effect. A single note of a pure tone which had a duration of 0.6 second, a frequency of 1800 cps, and an intensity approximating that of the natural call and which was repeated every 2.5 seconds was as effective as the natural call. Such a call approaches the minimal stimulus for the reproductive behavior of females of this species.

Microfilm $2.50; Xerox $3.00. 41 pages.

COMPARATIVE CHROMATOGRAPHY OF DROSOPHILA SPECIES AND OTHER SPECIES OF DIPTERA

(L. C. Card No. Mic 59-6727)

Lynn Hiram Throckmorton, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Marshall R. Wheeler

Paper chromatographic methods were used to compare 208 species of Diptera. The majority of these species were from the genus Drosophila (Drosophilidae), and they represented five of the subgenera and 26 of the species groups in the genus. Ten species from five other genera in the family Drosophilidae were also studied. In addition, 39 species representing 32 genera from 17 other families of Diptera were studied.

Chromatograms were obtained from late third-instar male larvae and from ten-day-old adult males of Drosophilid species. Chromatograms from non-Drosophilid species were from adult males only. Heads and bodies of adults were chromatogramed separately. Results were recorded as semiquantitative estimates of the compounds detected.

The major compounds investigated were: drosopterines isoxanthopterin, sepia pteridine, 2-amino-4-hydroxypteridine, biopterin, uric acid and xanthurenic acid. Several unknown compounds were noted and their distribution was recorded.

Chromatographic patterns of species were compared with respect to taxonomic groupings and, where known, with respect to the phylogeny of the groups concerned. Results indicated that the major differences between Drosophilid species were of a quantitative nature. Both quantitative and qualitative differences were present between representatives of the families of Diptera studied. There was a marked similarity between chromatographic patterns of closely related species. Results indicated that chromatographic methods demonstrate characteristics of a species which, when correlated with morphological and other characteristics of the species, can be useful for taxonomic purposes.

Results from Drosophila species indicated that chromatographic patterns of larvae are much less variable from species to species than are chromatographic patterns of adults. Differences here tend to separate species into large groups corresponding to major evolutionary lines within the genus.

Results from heads of adults from Drosophilid species show that chromatographic patterns from heads are relatively constant. Major differences between chromatographic patterns of heads are seen when species are compared at the generic or family level. Differences in pteridine accumulation in the heads will be most useful for showing relationships at the higher taxonomic levels.

Results from the bodies of Drosophila species show a marked quantitative variation of pteridine accumulation, particularly between groups of species. When chromatographic results are correlated with the phylogeny of the groups concerned, it is apparent that there has been a marked evolution of pteridine metabolism within the genus. Accumulation of pteridines in the male body is primarily in the testes. The course of pteridine evolution in the genus Drosophila has been toward a continual reduction of pteridine accumulation in the testes, and particularly toward the elimination of drosopterine accumulation by the testes. Comparisons can be made between pteridine accumulations in testes and analogous accumulations of pteridines in the eyes of several eye-color mutants of Drosophila melanogaster. These comparisons suggest that reduction of pteridine accumulation in the testes has been accomplished in different ways in different phylogenetic lines within the genus Drosophila. As a consequence of this reduction, many widely separated species in the genus have markedly similar chromatographic patterns. This type of convergent evolution makes it necessary that a wide variety of species in any group be investigated before an attempt is made to utilize patterns of pteridine accumulation in the body for taxonomic purposes.

Microfilm $2.50; Xerox $7.80. 169 pages.

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